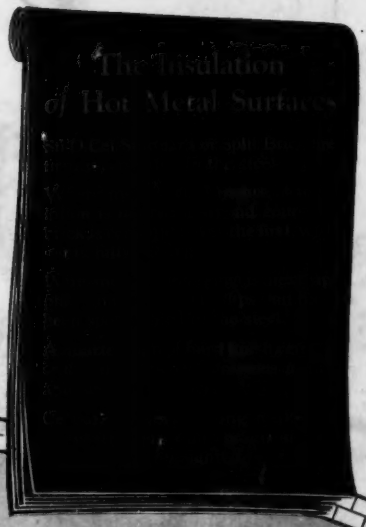
The REFINER AND NATURAL GASOLINE MANUFACTURER

Heat Insulation at Its Lowest Cost



THE Sil-O-Cel method of insulating hot metal surfaces costs less per square foot of coverage than any other type of construction of equal insulating value which will withstand temperatures in excess of 550° Fahrenheit.

It offers important advantages that could not be secured were the insulating units of larger size.

Every inch of insulation is in direct contact with the steel — sealed to it with heat-proof sticking cement. Not one chance for drafts inside the insulation.

Joints are small, and thoroughly filled with mortar. Where two courses of brick are used, joints in both directions are broken.

Rivet heads are easily bridged by gouging out the brick to accommodate them, or seams may easily be left bare for inspection.

Every job is a standard job. The same unit that fits a flat surface fits at corners and over curved ends. You warehouse only one shape, one type of insulation to cover every requirement.

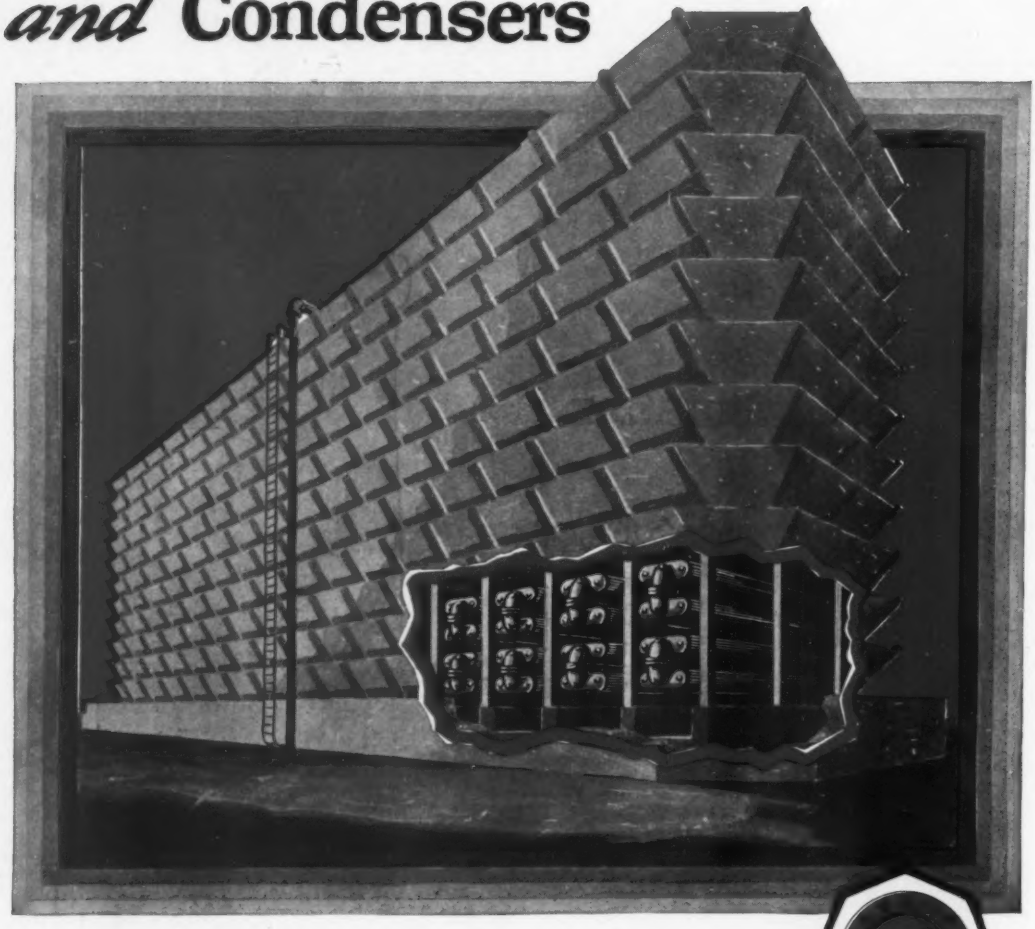
Write for full information on insulating with brick, to Celite Products Company, 11 Broadway, New York, or 53 W. Jackson St., Chicago or 1320 So. Hope St., Los Angeles.

SIL-O-CEL

BARRIERS

BRAUN

Open Type Coolers *and* Condensers

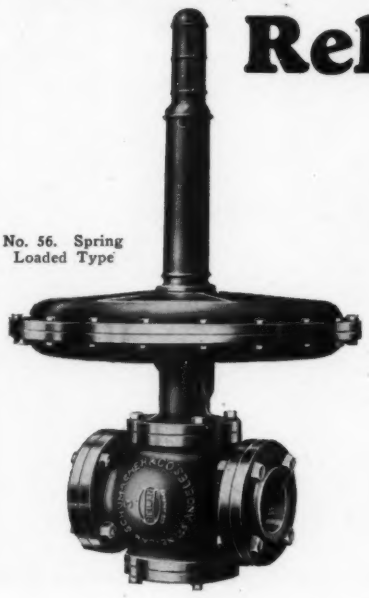


DESIGNED structurally to form a compact unit with the standard Braun Cooling Tower. There is an obvious advantage in purchasing tower and open cooler as a unit from one manufacturer, whose guarantee covers both.

C·F·BRAUN & CO
Manufacturing Mechanical Engineers
ALHAMBRA·CALIFORNIA
NEW YORK·DALLAS·TULSA
U·S·A

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

Neilan Vapor Recovery Relief Valves



No. 56. Spring Loaded Type

No. 51. Lever and Weight Type

Designed especially for controlling the recovery of vapors from flow tanks, run tanks, and storage tanks

Neilan Vapor Recovery Relief Valves are extremely sensitive, accurate and reliable, and assure safe and complete recovery of vapors from tight tanks.

They will maintain atmospheric, or any desired pressure above atmosphere and up to 4 ounces; and relieve all excess pressure into the vacuum system.

At any set pressure the variation will not exceed ¼-inch of water.

The vacuum on the outlet side of the valve cannot reach the tank. The valve closes promptly when the pressure in the tank has been released, regardless of how much vacuum is exerted on the outlet side of the valve by the compressor.

Both valves have large capacities and will regulate accurately over the entire capacity range. Identical in construction except that No. 51 is of the lever and weight type, and No. 56 is spring loaded. Both have the same capacity and pressure range. A cushioning device prevents chattering or pulsating. There are no dash pots or stuffing boxes. Descriptive folder sent on request.

NEILAN, SCHUMACHER & CO.

641-651 Santa Fe Avenue, Los Angeles, California.

Branch: 307 East 4th St., Tulsa, Okla., P. H. Wilkinson, Mgr.

Representatives:

Maintenance Engineering Corp., 2000 Harrington Street, Houston, Texas

NEILAN

Pelican Well Tool & Supply Company, Shreveport, La.

"You Can Be Sure of Neilan Products"

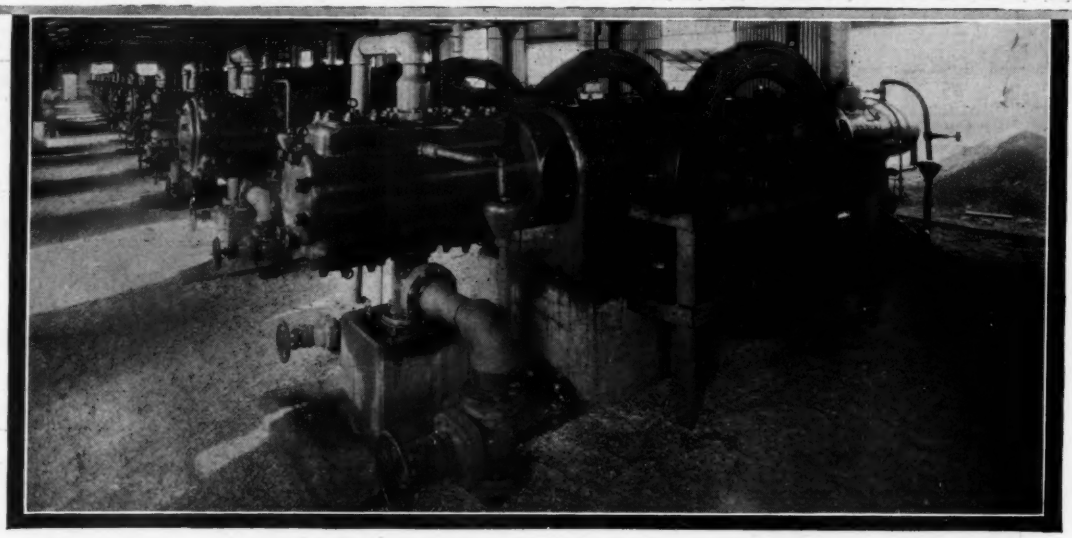
10,000 HORSE POWER O

in I.T.I.O. flowing Stations-

Seminole, the lode-stone of petroleum! Daily supplying hundreds of thousands of barrels of crude to refinery and pipe line. What a remarkable contrast between this modern oil field, and those of the past. Here every development of importance to the Oil Industry, the latest equipment, and scientific methods, make it possible to maintain maximum production with minimum expense in handling. With greater convenience, and in less time.

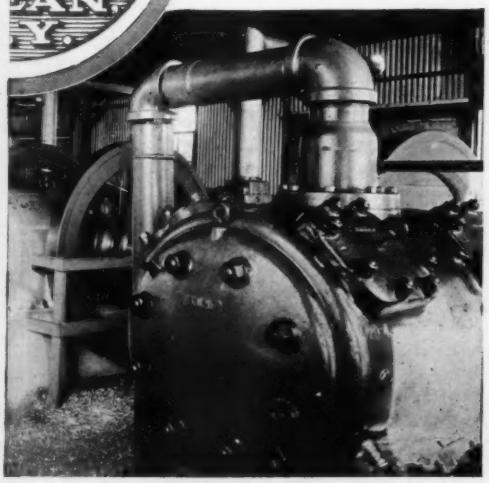
Clark Compressors, installed for air and gas-lift flowing wells, represent one phase of this new era which has opened up greater possibilities for the oil operator. The economy and dependability of Clark Compressors, due to the ruggedness and simplicity of their design, has made them the logical choice of producing companies who look for equipment tuned to the present day needs of the industry. That Clark Compressors have advanced, to keep step with the progress made in Petroleum Engineering, is a fact that has been favorably commented upon many times by engineers who thus explained their preference for these compressors.

F CLARK COMPRESSORS-



-in the Seminole District-

Yet in the final analysis, it is the plant operator who influences the producer's choice in the matter of compressor equipment. And from these men, the actual operators who "live" with their compressors, Clark Compressors receive their highest praise. Many operators who have used Clark equipment, would much rather operate a Clark than any other compressor; some will have no other. In stating their reasons why they say: "The Clark Compressor has the greatest overload capacity. It has no valves to grind——practically 100% operating efficiency is nothing unusual. Simple to operate. Centralized operating control—operator is in no danger from moving parts. And because it is readily accessible." Write for full detailed information to Clark Bros. Company, Olean, N. Y. Mid-Continent branch and warehouse at 125 W. First St., Tulsa, Okla. Other warehouses at McCamey and Sweetwater, Texas, and Artesia, N. M. Also Smith, Booth, Usher Company, 228 S. Central Ave., Los Angeles and 50 Fremont St., San Francisco.



BUY STEEL REFINING EQUIPMENT FROM AN OLD ESTABLISHED MANUFACTURER!

OVER A Quarter of a century's experience manufacturing oil refinery equipment places us in an ideal position to satisfactorily fill your needs. Prompt attention given to all orders, inquiries or correspondence.

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EXHAUST PIPES and PITS —*For Natural Gasoline Plants*

"UNITED" Exhaust Pipes and Pits are made from an acid and heat resisting mixture of cast iron, which insures their withstanding the acidity and high temperatures of the exhaust from internal combustion engines. Explosion doors having breaking pin safeties are provided in the conical top of the pit. When explosions of raw gas occur in the pit, the pins break and the opened doors instantly relieve the high pressure in the pit. The fumes are discharged through pipe stacks to any desired elevation.

PORTABLE, SAFE, EFFICIENT, DEPENDABLE

"UNITED" Exhaust Pipes and Pits are made for all types of internal combustion engines. They are easily taken apart and quickly assembled. They are the most efficient method for disposing of exhaust gases from engines in natural gasoline plants on the market today. They will last indefinitely.

CIRCULAR UPON REQUEST

Manufacturers of RIG IRONS and STEEL EQUIPMENT STEEL TANKS DRILLING MACHINES SWAB BARRELS

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IRON WORKS, Inc.
KANSAS CITY, MO.

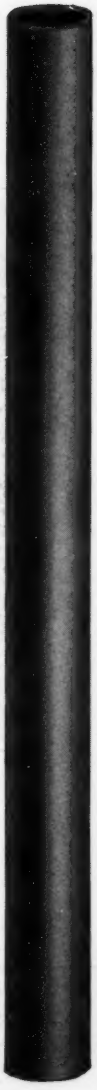
TULSA, OKLA.
114 N. ROSEDALE

"UNITED" IRON WORKS INC. FOR SERVICE

DALLAS, TEXAS
MAGNOLIA BLDG.

Controlled processes 1

2 Controlled quality



CAN you rely on the quality of your present tubing? Are you taking every precaution to insure maximum service from the tubes you use? The Pittsburgh Seamless processes of making seamless tubing permit us to control its quality from the making of the steel itself to the finished pipe. This keeps quality uniformly high—always. Seamless Tubing is our specialty—the only thing we make. Every tube is flawless and hydraulically tested before we ship it to you. Pittsburgh Seamless is recommended for

Still Tubes — Boiler Tubes Power Piping

Pittsburgh Seamless Tubes are made by piercing solid billets of basic open hearth steel. The severe treatment given the metal in the process of manufacture *conditions* the steel and either works out the flaws or shows them up for rejection. The result is a perfect, flawless tube of exceptional strength and toughness that is especially able to withstand any strain it might receive in refinery practice. Every tube is hydraulically tested before it leaves our plant.

For Power Piping

Pittsburgh Seamless is far superior to welded pipe for Power Piping. Every inch of weld in a welded tube is a point of potential failure. The expansion and contraction, especially at bent sections, will, in many cases, cause a rupture at the weld—its weakest point.

There are no weak points in Pittsburgh Seamless. Consequently it will stand up longer under the severe strain and appreciably cut down the cost of repairs and replacements.

Largest Exclusive Makers of Seamless Tubing in America

For over 20 years our entire resources have been focused on one objective—how to make a better seamless tube. Today our methods are the most up to date that engineers and scientists have developed. Due to this carefully concentrated attention on only one type of tubing, we have become the largest company in America devoted exclusively to its manufacture.

Pittsburgh Steel Products Co.

DIVISION OF

Pittsburgh Steel Co.

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Pittsburgh Seamless

Why do Leading Refiners Prefer Laclede-Christy Flat Arches?

Because—

1. No loose pieces—entire structure bolted together, making one unit—physically impossible for any section or piece to fall in.
2. Bolted castings provide positive spacing of tile, eliminating strains which are main causes of spalling.
3. Easy to erect—photograph above shows simplicity of supporting structure and provision for easy hanging of tile.
4. And last, but not least, Laclede-Christy Arch Tile—the highest grade material for this purpose. Costs no more than ordinary tile.

They Do Last Longer!

Write LACLEDE-CHRISTY, St. Louis, U. S. A., *for detailed information*

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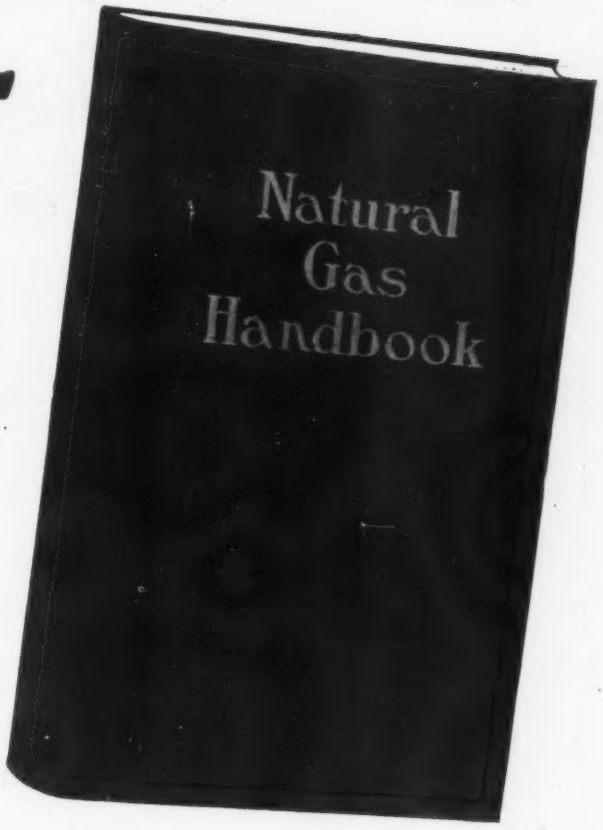

Limited 1927 Edition is Now Available

The Basic Book of Natural Gas

THIS is the 4th edition of the book which has been the basic authority of the natural gas industry since its first appearance in 1913.

It has run through three editions in less than twelve years without any particular effort being made toward distribution. The 3rd edition was exhausted early in 1925. The new edition is presented to meet the demand that has continued and increased since that time.

This book contains the most comprehensive and authoratative information suitable to the uses of the natural gas engineer; and complete tables for ready reference by the practical worker. It is considerably advanced in many ways over previous editions; there are new tables and much other valuable data that have not hitherto been made available, and which will be available exclusively in this book.

METRIC METAL WORKS
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GENTLEMEN:

Enclose find $.....for which mail, postpaid, the 4th edition of the "Natural Gas Handbook," as follow:

.....copies at $5.00 each—Bound in Cloth

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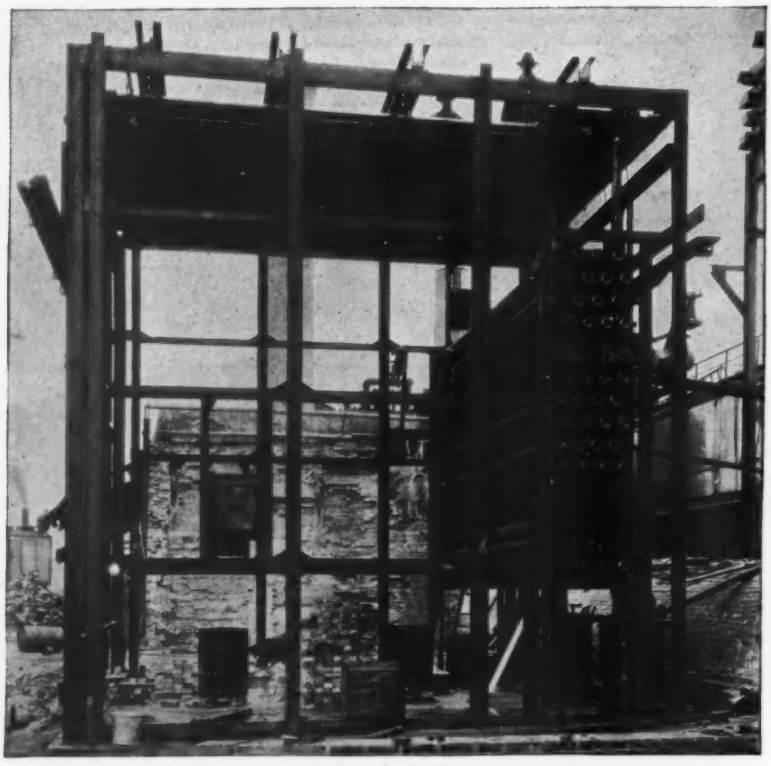

No expansion strains in Foster Tube Stills

Foster Tube Stills do not depend on the brick setting for support. As in modern office building construction, a sturdy steel framework carries the entire load of the structure.

Foster design, therefore, permits independent expansion of heating elements and setting, so that expansion will not tend to loosen any joints of the still.

Besides this assurance of long life, over 600 installations have also proven the highly economical fuel consumption of Foster Tube Stills and their ability to operate at high temperatures without danger of overheating the oil or the still.

FOSTER

FOSTER WHEELER CORPORATION
formerly Power Specialty Co. and Wheeler Condenser & Engineering Co.
111 Broadway, New York City
Branches in principal cities.

The TUBE STILLS with the protected surface

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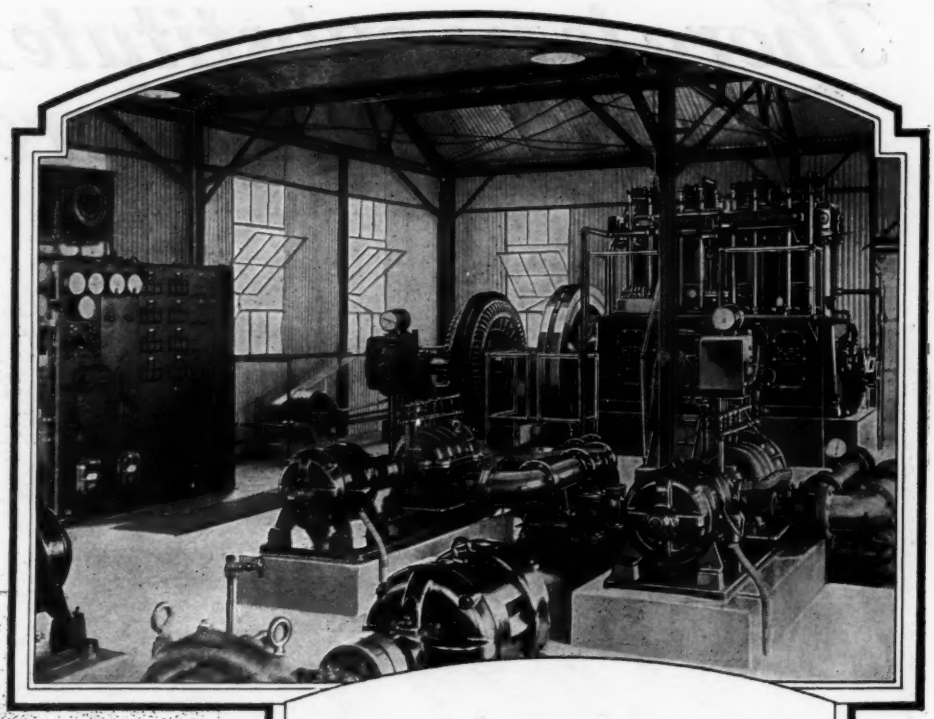
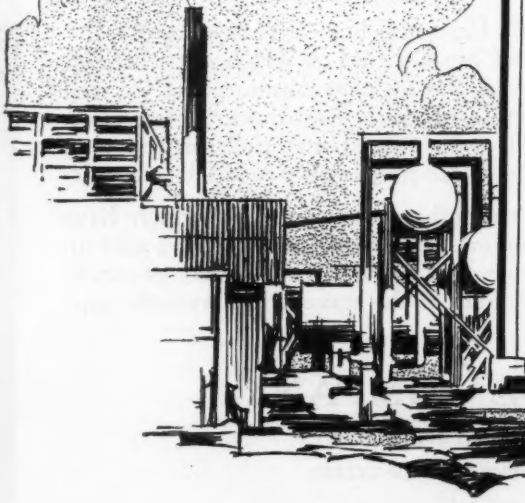


Hope Gas Engines
for Dependable Auxiliary
Power



If the judgment of the men responsible for the planning of the more recent and model main line gas compressor stations is sound—
If the performance record of the equipment of their choice is any guide—

There is every reason for your decided preference for Hope Gas Engine reliability as a guarantee of trouble-free power generation for driving the auxiliaries.

May we tell you, in detail, of what Hope Gas Engines are doing—and where their performance in the field tells the story?

Your request for information on these engines will bring you Specification Data of interest.

H-E-41.

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ENGINEERING AND SUPPLY
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There is no substitute for Dependability here!

IN this heat exchanger built of "NATIONAL" Pipe, the hot oil runs between the 2-inch and the 4-inch pipe for the purpose of heating cold oil which runs through the 2-inch pipe. Expansion and contraction are factors for consideration here, as well as good tight joints—the result of clean, strong threads. Resistance to corrosion both inside and outside and clean, smooth walls which assist materially in reducing loss by friction, add importance to the selection of the proper pipe for such purposes.

The qualities of uniformity of material, great strength, durability, etc., which have made "NATIONAL" Products so much in demand in the producing field are also inherent in "NATIONAL" Pipe for refinery service. This is why it is so generally used by the larger refineries and recognized by them as the standard of wrought pipe for refinery purposes.

NATIONAL TUBE COMPANY

Frick Building, Pittsburgh, Pa.

DISTRICT SALES OFFICES IN THE LARGER CITIES

"NATIONAL" Seamless Couplings are available in all sizes and types for any refinery or oil country purpose.

NATIONAL

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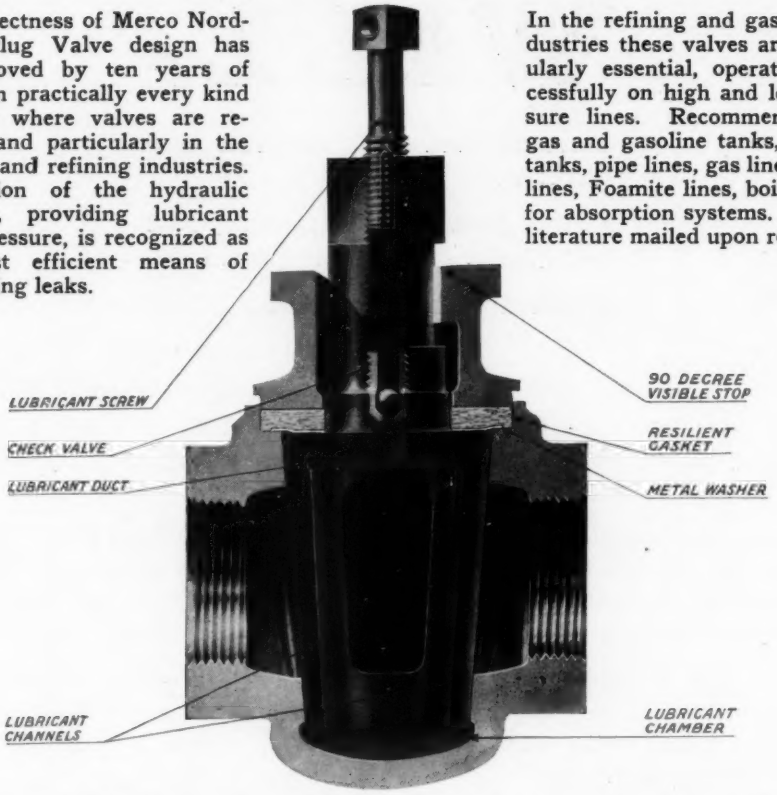
won't stick/ won't leak/

Merco Nordstrom Plug Valves

The correctness of Merco Nordstrom Plug Valve design has been proved by ten years of service in practically every kind of plant where valves are required—and particularly in the gasoline and refining industries. Application of the hydraulic principle, providing lubricant under pressure, is recognized as the most efficient means of overcoming leaks.

In the refining and gasoline industries these valves are particularly essential, operating successfully on high and low pressure lines. Recommended for gas and gasoline tanks, storage tanks, pipe lines, gas lines, steam lines, Foamite lines, boilers, and for absorption systems. Special literature mailed upon request.



No foreign matter can pass the film of lubricant. No joints or grooves in which foreign matter can lodge. The plug is held in its seat at all times. Turning of the lubricant screw creates hydraulic pressure up to 2000 pounds per square inch.

MERCO NORDSTROM VALVE CO.

SUBSIDIARY OF THE MERRILL COMPANY

Engineers— ***Manufacturers***

San Francisco, 121 Second St.
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MERCO

New York, 11 W. 42nd St.
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Western Factory: Oakland, California

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SUNOCO

Absorption Oils

630 *and* 670

WILL

Increase your daily gasoline production.

Lower your manufacturing cost per gallon of gasoline produced.

Control your end points.

These desirable results are obtained by careful control of the distillation range of these oils. A short boiling range provides a low molecular weight oil, which has a greater absorption capacity.

The number of companies using "SUNOCO" Absorption Oil is proof of its unquestionable quality. We ask an opportunity of supplying you with your future requirements.

Our Engineering Department will be glad to co-operate with you in the development of your plant and will give you the benefit of our research work pertaining to Absorption Oils.

SUN COMPANY

Petroleum Bldg., Tulsa, Oklahoma

Refineries at

Marcus Hook, Pa. Yale, Oklahoma Toledo, Ohio

Mention Where You Saw the Advertisement

Use Steam Over Again

ONE pound of steam can be made to do the work of 2 pounds in the steam distillation of heavy oils by the use of a Wheeler steam jet thermo-compressor. The oil is condensed out of the steam-oil vapor mixture from the still at a comparatively high temperature. The steam is recompressed by the thermo-compressor, and re-introduced into the still. One pound of high pressure steam used in the thermo-compressor will compress an equal or greater amount of exhaust steam from atmospheric pressure to a usable still pressure. Over 90% of the heat which would be required to generate this re-compressed steam is saved. (All the heat of vaporization and a good part of the heat of superheat.) Thermo-compressors can be built for any specified pressure.

FOSTER-WHEELER
Oil Refinery Equipment

HEAT EXCHANGERS
(Liquid to Liquid)
VAPOR HEAT EXCHANGERS
FINAL CONDENSERS
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Other Products Include:

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Bulletins describing any of our products will be sent upon request.

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Successors to Power Specialty Company and Wheeler Condenser & Engineering Co.

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Works: Carteret, N. J., Danville and Newburgh, N. Y.
St. Catherine, Ont., Canada, Egham, Surrey, England.

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FOREIGN
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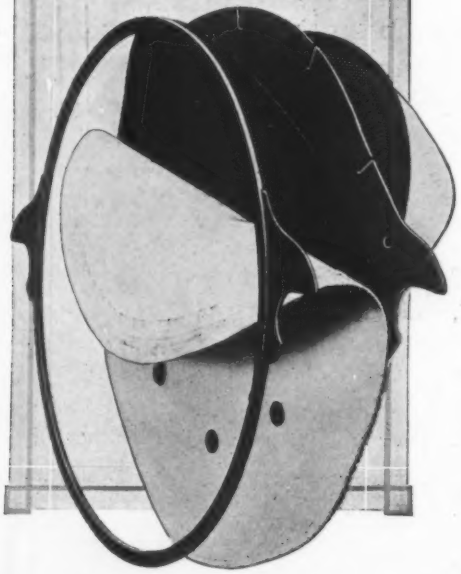
Making Filter Plates *For The Wax Plant*

WHERE THE WAX FILTER PLATES ARE ASSEMBLED



A LOOSE RING FILTER PLATE

WHERE facilities are combined with experience a superior product results.

Vogt WAX FILTER PRESS PLATES

are the best that can be made. The work is systematically done in a specially equipped shop by trained men.

Write for Bulletin

Henry Vogt Machine Co.
INCORPORATED
LOUISVILLE, KY.

Branch Offices: New York, Cleveland, Philadelphia, Chicago, Dallas

Manufacturers of: OIL REFINERY EQUIPMENT, DROP FORGED STEEL VALVES AND FITTINGS, WATER TUBE AND HORIZONTAL RETURN TUBULAR BOILERS, ICE MAKING AND REFRIGERATING MACHINERY.

Check Over Your Storage Tanks

Are your storage tanks standing up under the ravages of rust, rain, time and pressure? Check over each one in your plant and see how many show seepage leaks.

KAW Storage Tanks are famous for their age-defying, weather-resisting qualities. Designed and fabricated by master workmen in a plant with every modern facility for finest construction, they assure **longer** years of trouble-free service.

Check over your storage tanks and let KAW save you money on cost of the new ones you need. Write, wire or phone for prices.

KAW STEEL CONSTRUCTION CO.

General Office and Plant: **1st and Walker Avenue, Kansas City, Kansas**

Did an electric flash start this fire?

Every electric motor in use where inflammable liquids and explosive gases are present, should be started or controlled by EC&M flame-proof, oil-immersed equipment.

EC&M Oil-immersed Automatic Starters are available for all sizes of motors from ¼ to 650 Horse Power. They are built for squirrel cage, slip ring and synchronous motors.

Why risk the hazard of starting your motors with equipment which is not entirely flame-proof? EC&M control equipment is flame-proof because every main contact is under oil and auxiliary contacts are broken either under oil or in a vacuum.

Many oil companies have standardized on EC&M Control Equipment. Have you?

Send for Bulletins 1042-F, 1047 and 1048

EC&M
Automatic Compensator

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK-50 CHURCH ST. CHICAGO-CONWAY BLDG. DETROIT-DIME BANK BLDG. BIRMINGHAM-BROWN-MARX BLDG. CINCINNATI-FIFTH NATIONAL BANK BLDG. MONTREAL-DRUMMOND BLDG. LOS ANGELES-AMERICAN BANK BLDG. SALT LAKE CITY-228 W. SO. TEMPLE TORONTO-REFORD BLDG. PHILADELPHIA-WITHERSPOON BLDG. PITTSBURGH-OLIVER BLDG. SAN FRANCISCO-CALL BUILDING SEATTLE-570 COLMAN BLDG. TULSA-217 E. ARCHER ST.

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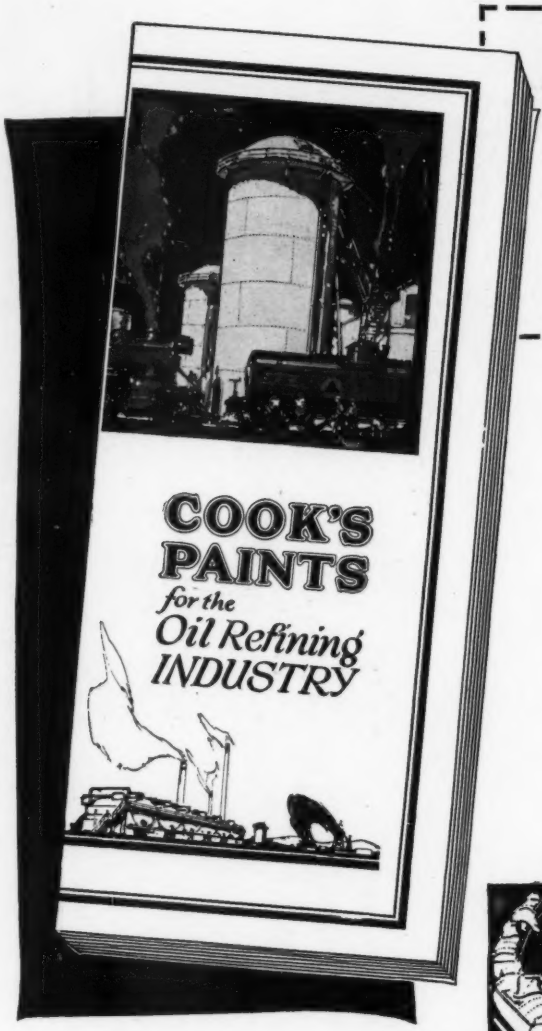

FREE! Your Copy of This Book

If you own oil refining equipment and are interested in its economical maintenance, you will find this booklet of value.

COOK PAINT & VARNISH COMPANY
Oil Industry Department, Kansas City, Missouri.
Gentlemen: Please send me without obligation your book of specialized paints for the Oil Refining Industry.

Company _____

Name _____

Address _____

STEEL-KOTE is one of the paints made by Cook's especially for use by the petroleum industry. It is recommended where extreme protective qualities and durability are desired. The highly basic pigments and special heat-treated oils used in its manufacture insure a tough, elastic paint film that will prevent rusting, pitting and corrosion.

Steel-Kote is economical and efficient because it is practical for either brush or spray application. It covers better and spreads farther than ordinary paints. It dries under all sorts of conditions. And it wears and wears and wears!

When repainting over old paint apply Cook's Steel-Kote direct. Unpainted metal surfaces require a priming coat for which we recommend Cook's Rust Inhibitive Primer.

STEEL-KOTE
for tank cars.

Cook's Service Men working out of our mid-continent branches are specialists on the subject of paints and painting for the oil industry. It is a pleasure to discuss your problems with you, and to recommend the particular type of paint you need. An inquiry involves no obligation on your part.

Cook Paint & Varnish Company

Factories: Kansas City—St. Louis—Fort Worth Houston—Cincinnati.

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The way to fight pipe line corrosion

Coat the pipe with Johns-Manville Asphalt Cement, seal on a protecting envelope of Johns-Manville Asbestos Pipe Line Felt, then a final coat of Johns-Manville Asphalt Cement outside — and the job is done to stay. The result is a rot-proof armor, approximately ¼" thick, tightly sealed against the pipe, without air spaces. This is real protection, by far the most economical.

JOHNS-MANVILLE

Oil Industry Department

JOHNS-MANVILLE CORPORATION, MADISON AVENUE AT 41ST ST., NEW YORK. BRANCHES IN ALL LARGE CITIES. FOR CANADA: CANADIAN JOHNS-MANVILLE CO., LTD., TORONTO

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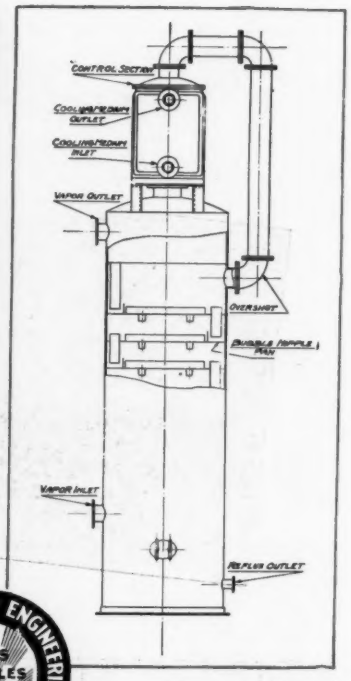
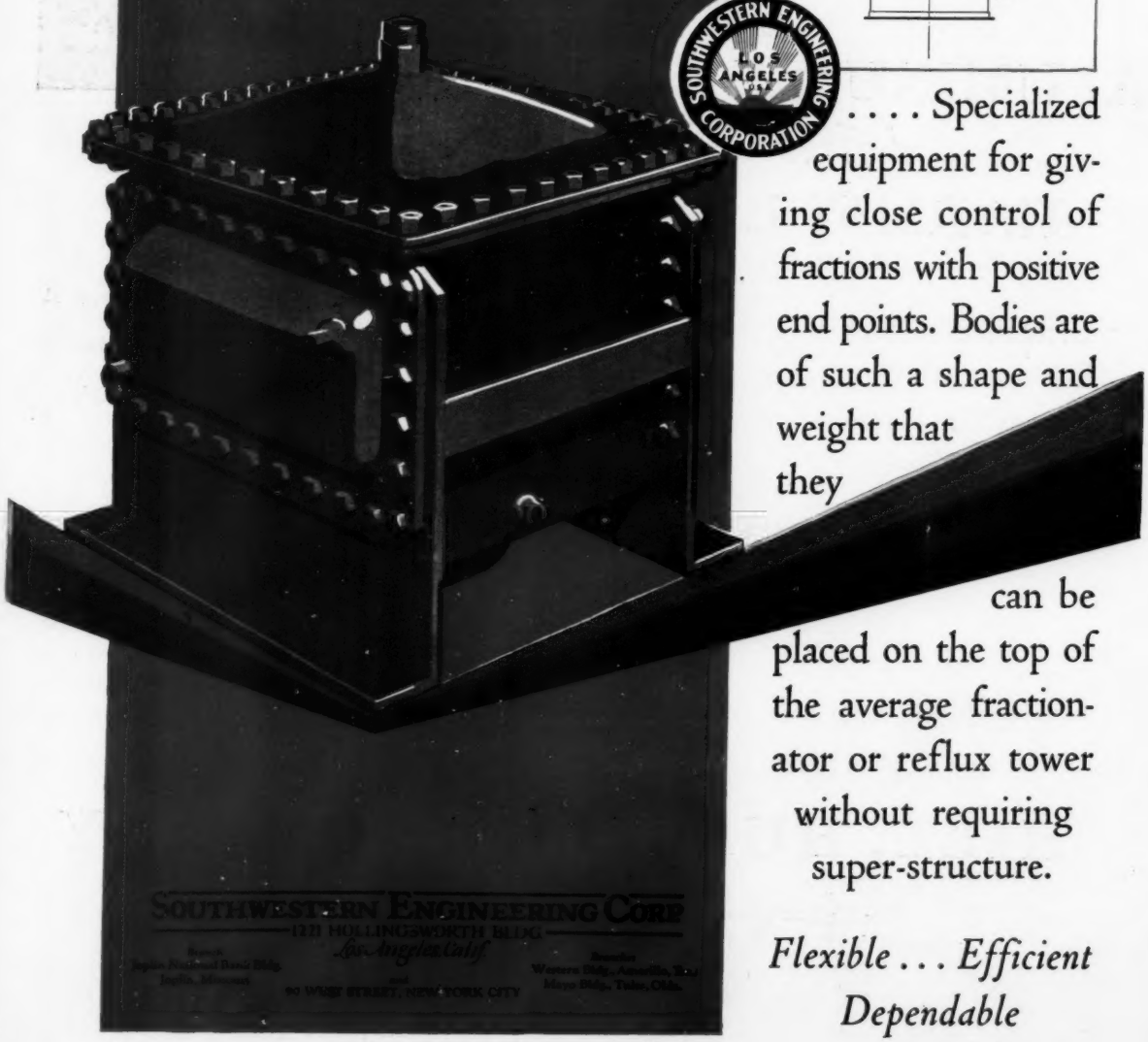
SOUTHWESTERN REFLUX CONDENSERS





SOUTHWESTERN ENGINEERING CORPORATION LOS ANGELES U.S.A.

. . . . Specialized equipment for giving close control of fractions with positive end points. Bodies are of such a shape and weight that they can be placed on the top of the average fractionator or reflux tower without requiring super-structure.

Flexible . . . Efficient
Dependable

SOUTHWESTERN ENGINEERING CORP
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Los Angeles, Calif.

Branches
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Branches
Joplin, Missouri
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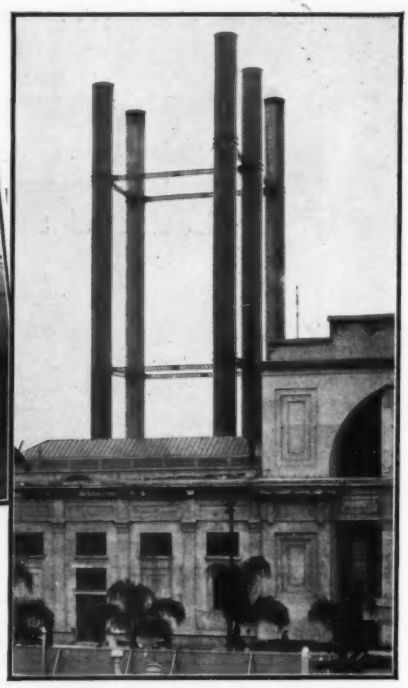
Mention Where You Saw the Advertisement

Right: Smoke stack painted with Bitulumin.
San Diego Cons. G. & E. Co.

Lower: Associated Oil Co. Tank Car.



ALUMINUM PAINTS *deflect* HARMFUL SUNRAYS

BITULUMIN'S Sunray Deflection 86% Keeps Tanks and Contents Cooler Minimizing Evaporation

THE rapidly increasing use of Aluminum Paints in general and Bitulumin in particular for protecting a variety of exposed metal surfaces is due to their unusual protective qualities.

Bitulumin successfully resists paint's two worst enemies, sunlight and moisture. It is largely immune to Ultra Violet rays which break down paint surface, allowing moisture to penetrate.

Bitulumin turns away approximately 86% of harmful sunrays thus keeping tanks and contents cooler and minimizing evaporation.

Bitulumin forms a light resisting durable and moisture proof surface. It will outlast the best lead and zinc paints by two to one.

Bitulumin, while widely used for painting oil storage, is equally efficient on tank cars, metal buildings, refinery equipment, still towers, water tanks, bridges, etc.

Bitulumin, put up in double containers to insure fresh mixing, is manufactured by Hill, Hubbell & Company, manufacturers of a special line of paints for the oil industry.

HILL, HUBBELL & COMPANY

Manufacturers of
Highest Grade Oil Industry Paints and Pipe Line Coatings

Factories at SAN FRANCISCO and TULSA

District Offices:

LOS ANGELES HOUSTON NEW YORK CITY
SEATTLE PORTLAND BALTIMORE

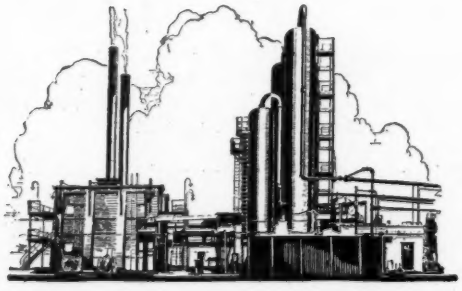
Mention Where You Saw the Advertisement

KELLOGG PIPE STILLS

SERVICE
to the refiner

Kellogg welcomes the opportunity to be of service to the refiner in planning the construction of pipe stills, and related equipment.

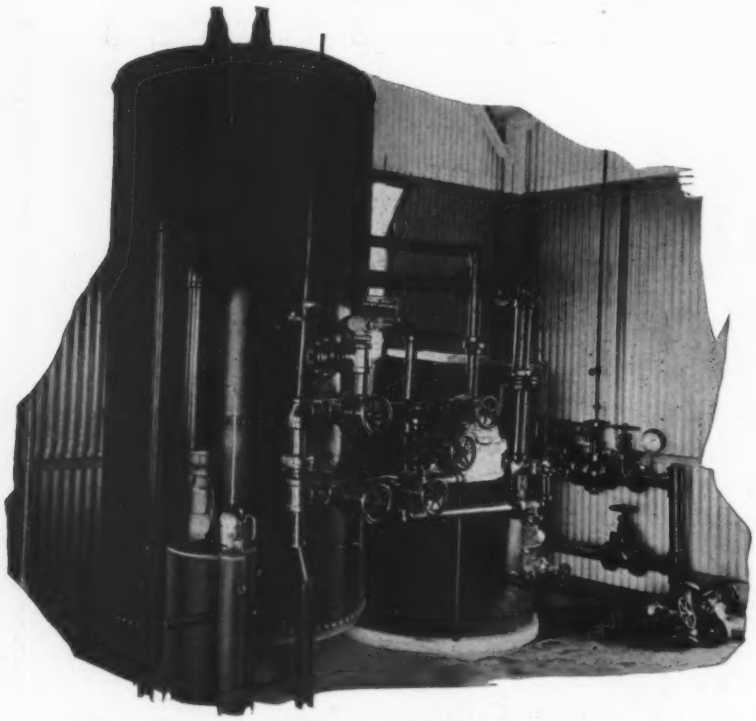
If you will outline your requirements, stating the results to be obtained and the products desired, Kellogg engineers will design the necessary plant, and guarantee the performance of the equipment recommended.



KELLOGG

CROSS CRACKING PLANTS—BUBBLE TOWERS—PIPE STILLS—HEAT EXCHANGERS—GRAY TREATING TOWERS—TREATING PLANTS

THE M. W. KELLOGG CO., 7 DEY STREET — NEW YORK
KANSAS CITY, MO., 700 BALTIMORE AVE. — SAN FRANCISCO, CAL., 444 MARKET ST.
LOS ANGELES, CAL., 329 PETROLEUM SECURITIES BLDG.



A typical Paige-Jones installation that furnishes softened water for cooling systems. This is in one of the Sinclair Oil and Refining plants.

Soften The Water Used In Cooling Jackets

It's Much Safer

A recent article in Oil Engine Power tells how a certain pipe line company eliminated all cylinder head failures by Zeolite treating the make-up water for the cooling system.

While at one of their new stations which had to be operated before its treating plant could be installed, they ran smack into a failure—but it was the *only* failure.

Zeolite treatment is the most effective way of eliminating the dangerous "scale-forming" hardness from cooling water.

The Paige-Jones Rapid Rate Upflow Zeolite System can give you this soft water protection at the lowest possible cost.

Let us tell you why in detail. Send for our new, graphically illustrated pamphlet "Softened Water—The Universal Need".

Paige - Jones originated and developed this more economical Zeolite system —the *rapid-rate, upflow system.*

Paige-Jones equipment comes in capacities ranging between a few gallons, to many thousands. Any oil or Diesel engine installation can be served.

Send for This Bulletin.

PAIGE & JONES CHEMICAL CO., INC.
General Sales Office, Technical Dept. and Works, HAMMOND, INDIANA
Executive Office: 461 FOURTH AVE., NEW YORK
Offices in Principal Cities

Be Assured of Paige-Jones Economies

PAIGE-JONES WATER SOFTENING

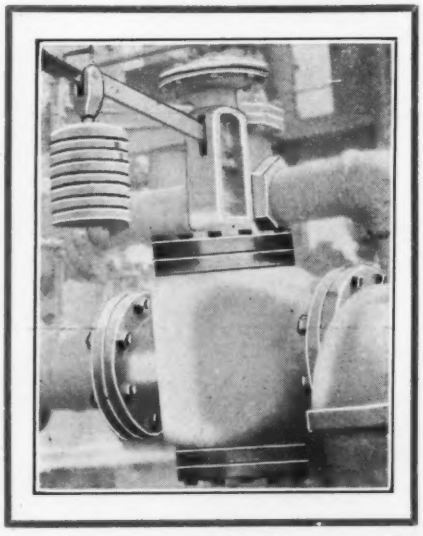
ZEOLITE AND LIME SODA SOFTENERS · PRESSURE SAND FILTERS
BOILER FEED WATER TREATMENTS · HOUSEHOLD WATER SOFTENERS

Mention Where You Saw the Advertisement

The Thinker

The big questions that so often harass the oil man confronted with puzzling control problems have invariably found their answer in FISHER.

FISHER
TRADE MARK
REGISTERED



The insert to the left shows an installation on the absorber towers in the Hull Gasoline Plant, at Winfield, Kansas, where a Fisher Type 14 maintains a pressure of 40 pounds that is always constant.

FOR example—"How am I going to maintain exactly a certain pressure?" "How can excessive pressure at a given point be relieved?"—the answer is FISHER Automatic Relief Valve, Type 14.

The valve is absolutely automatic, opening at the fixed working pressure and closing promptly after relieving the excess pressure above the working point, so that, except within the narrowest working limits, the pressure never exceeds the point for which it is set. Excessive pressure is impossible when controlled by this valve, and it is invaluable where a desired pressure must be maintained exactly.

THE FISHER GOVERNOR CO.

1318 FISHER BUILDING
MARSHALLTOWN, IOWA, U. S. A.

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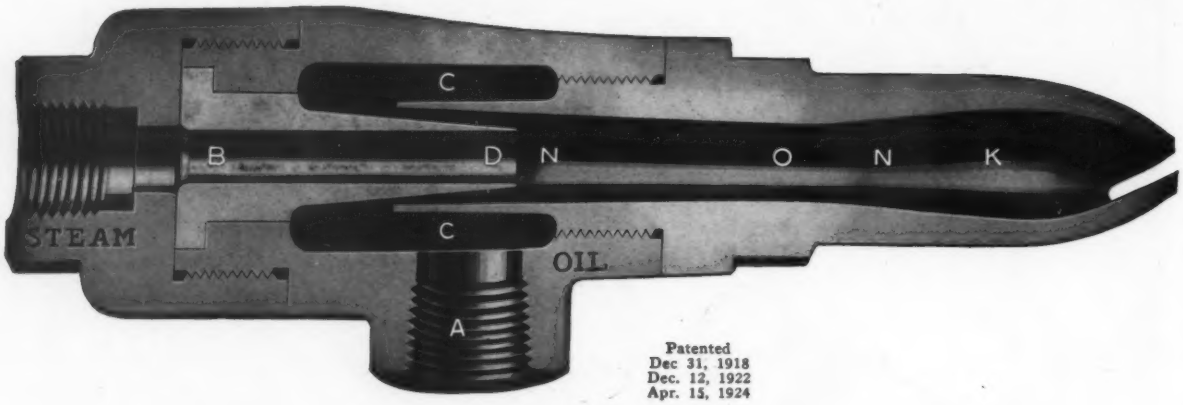
National Airoil Burners



Patented
Dec 31, 1918
Dec. 12, 1922
Apr. 15, 1924

For Power Plants and Stills and all Industrial Furnaces

NATIONAL AIROIL BURNERS
are internal atomizing burners—inside mixers—operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

NATIONAL AIROIL BURNERS
will handle the heavy residuum from cracking stills without requiring continual removal for cleaning, an immense factor in economical plant operation.

NATIONAL AIROIL BURNERS
when operating under boilers will use less than one per cent of the steam for atomizing the oil. The old style steam atomizing burners use from three to seven per cent.

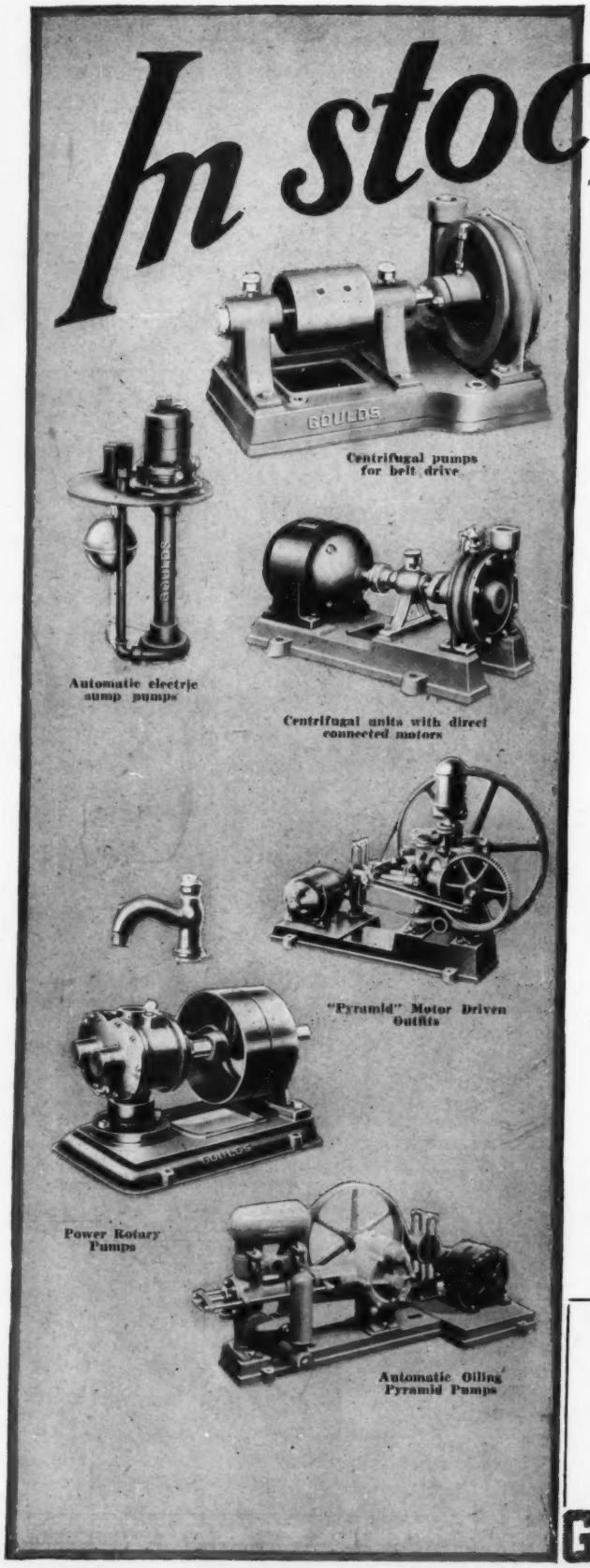
NATIONAL AIROIL BURNERS
give a soft gaseous flame that does not injure brick work or boiler tubes. Made with flat or round tips.

Write for our Bulletin No. 21

National Airoil Burner Company

Factory: S. W. Cor. 9th and Thompson Sts.
Sales Rooms: 1327 Girard Avenue
PHILADELPHIA, PA.

Oil Burners and Oil Burning Equipment


In stock—
Centrifugal pumps for belt drive
Automatic electric sump pumps
Centrifugal units with direct connected motors
"Pyramid" Motor Driven Outfits
Power Rotary Pumps
Automatic Oiling Pyramid Pumps

small power pumps for a multitude of purposes

These small and medium capacity pumps are adaptable to a wide variety of uses in industrial plants of all kinds. Some of their many uses are:

Handling fuel oil, kerosene, and gasoline; unwatering excavations; pumping enamel, paint, varnish and other viscous liquids; loading and unloading tank cars; circulating liquids in manufacturing processes; circulating brine; booster service; water supply, etc.

Carried in stock at our factory, branch warehouses; and at supply houses everywhere.

GOULDS PUMPS
Centrifugal, Triplex
Rotary, Vacuum, etc., for

Air Washing and Humidifying

Building Equipment Services
- Elevator Service
- Booster Service
- Ice Water Circulating
- Sump Pump Service
- Heating Systems

Construction Work
- Unwatering Excavations
- General Water Supply

Fire Protection

General Water Supply in
- Hotels
- Apartment Houses
- Office Buildings
- Industrial Plants

Irrigation

Mine and Quarry Service
- Drainage
- Cyanide Mills
- Flotation Plants
- Refineries

Waterworks, Filtration and Sewage Plants

Petroleum Industry
- Oil Pipe Lines
- Oil Refineries
- Gasoline Plants

Process Work— including such industries as:
- Coke and Gas
- Chemical—Cellulose—Paper—Food—Sugar—Textile

Refrigerating Plants

Steam Power Plants
- Boiler Feeding
- Economizer Service
- Condenser Service
- Fuel Oil

Goulds Pumps, Inc.
Seneca Falls, N. Y.

Date .....

Please send pump bulletins and specifications for—

Kind of Service .....

Name .....

Position .....

Company .....

Address RNGM-10

GOULDS PUMPS

Mention Where You Saw the Advertisement

IF it didn't cost a cent to store vast quantities of oil indefinitely—to say nothing of the evaporation losses—then wildcatting, gushers and new pools could multiply without endangering the price structure or wasting a National resource

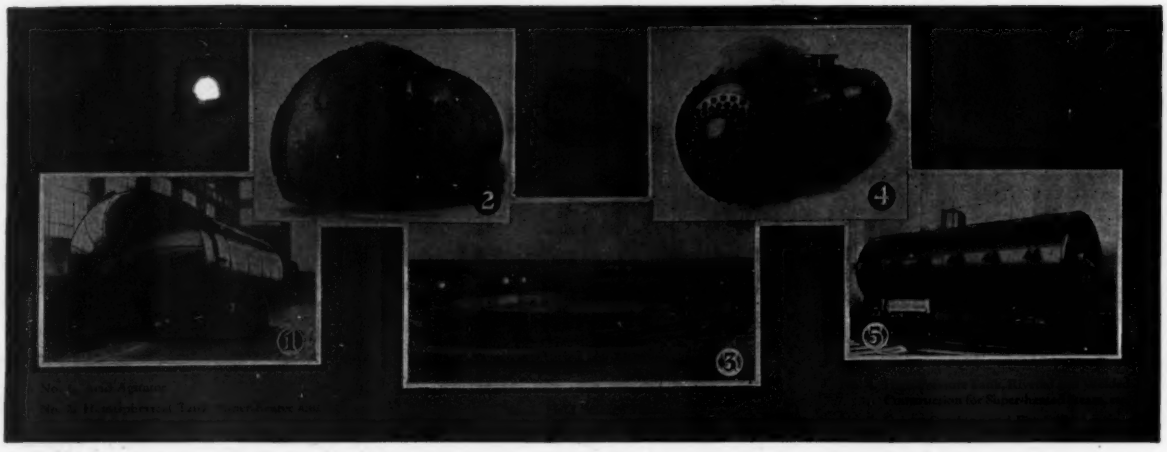
But since tankage costs money and interest has a habit of piling up, there are definite limits to our capacity to store oil above ground

Thus in "flood times" the inevitable happens—prices tumble, old refining methods, such as the skimming of crude and selling of fuel oil, are wastefully employed to obtain gasoline

A fine picture for a major industry! Let's paint a better one All that is needed is a good mixture of determination, fairness, knowledge and ability

These ingredients the industry has and should now use

Universal Oil Products Company
Owner of the Dubbs Process
310 South Michigan Ave
Chicago, Illinois



Headquarters for Heavy Steel Plate Construction

Biggs has specialized in the design and fabrication of heavy steel plate construction for more than two score years. In organization, manufacturing facilities and by actual experience with field conditions, Biggs is ideally equipped to handle every special as well as standard requirement of the petroleum industry.

Whether you need equipment like that illustrated above, or any of the products listed at the right, you will find Biggs a convenient and trustworthy source of supply—its performance up to specifications in every particular.

From design through construction to final installation, Biggs will handle as much or as little of any project as suits your convenience. When you place your order with this organization you can be certain of prompt delivery and accurate results in the face of severe operating conditions.

Our illustrated booklet *"What Biggs Does and How"* shows some of the reasons for Biggs outstanding position in price, delivery, performance and guarantee. Mail the coupon below for your copy today.

Manufacturers of

- Pressure Stills for Cracking Process
- Fractionating Towers
- Dephlegmating Towers
- Bubble Towers
- Heat Exchangers
- Agitators
- Steam Stills
- Crude Stills
- Condenser Boxes
- Run Down Tanks
- Blending Tanks
- Hemispherical Tanks
- Blow Cases
- Acid Tanks
- Compounding Kettles
- Storage Tanks to 80,000 Barrels
- Smoke Stacks and Breechings, etc.

THE BIGGS BOILER WORKS COMPANY

General Offices and Works: Akron (25) Ohio
Eastern Sales Office: 300 Madison Ave., New York City
Chicago Office: 35 S. Dearborn Street

Now is the right time to mail this coupon

THE BIGGS BOILER WORKS COMPANY
Akron (25) Ohio

Please send us, without obligation, a copy of "What Biggs Does, and How." We are interested in the following equipment.....

Please see us on or about .....

.....

Firm .....

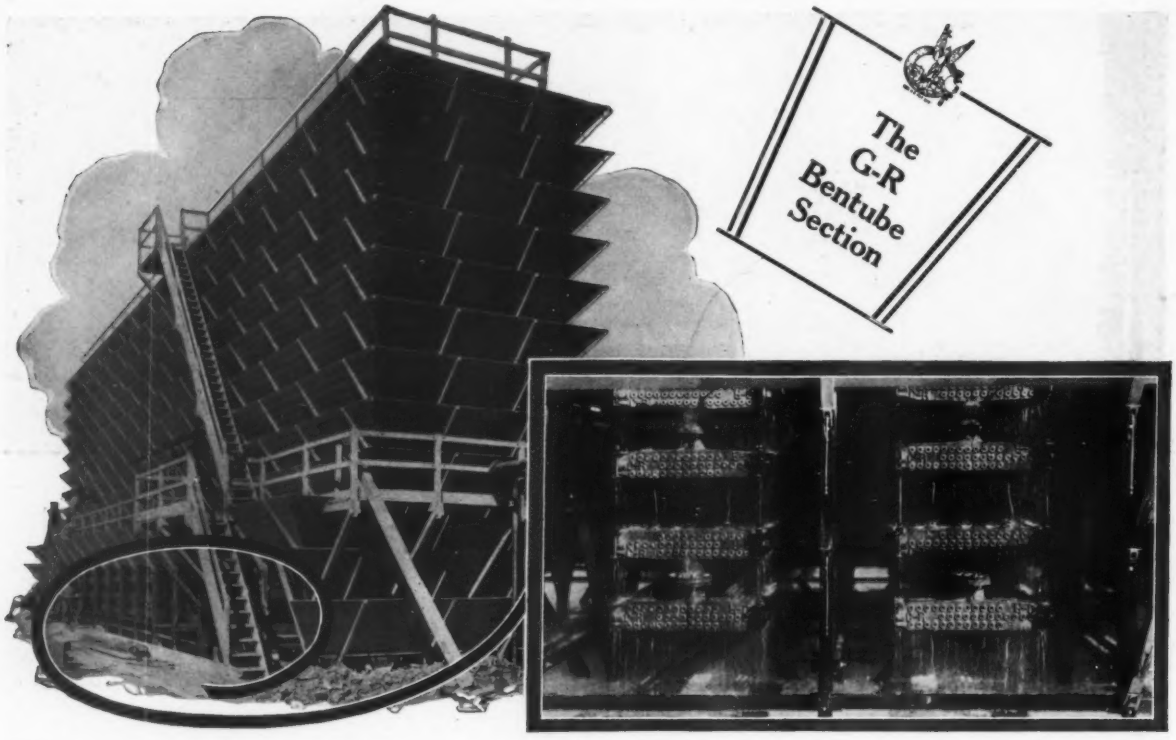
Individual . ...

Address . .....

The Biggs Boiler Works Co. Akron Ohio Est. 1857 — Trade Mark Registered.

TANKS AND GENERAL STEEL PLATE WORK *for the Oil Industry*

Mention Where You Saw the Advertisement



"Has every advantage"
for cooling oil, gas or jacket water —or condensing gasoline

THIS installation of G-R Bentube Atmospheric Coolers operating in conjunction with a Fluor Tower at the West Coast Refining Co. plant in California was described in a recent article as

> "a combination that has every advantage from the standpoint of standardized construction, ease of construction, portability and mobility, and uniform results in operation."

G-R Bentube Coolers are standard and interchangeable, consisting of units of Admiralty metal tubes connected to cast iron headers. These units can quickly be set up in banks and moved about the plant as required by operating conditions.

A unique advantage of the patent G-R Bentube Section is its scale-shedding feature, which permits definite guarantees of capacity to be made even with bad quality cooling water.

Although the design and construction of G-R Bentube Sections are far superior to that of other atmospheric coolers and condensers, their price is surprisingly low because of the large quantities in which they are built. Shipments can be made immediately from stock.

Write for ratings, prices and complete information on special features.

The Griscom-Russell Co.

285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
Boston	Detroit	New Orleans	Los Angeles
Rochester	Cleveland	Dallas	Seattle
Pittsburgh	Milwaukee	Houston	Salt Lake City
Columbus	Minneapolis	Atlanta	Tulsa
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For Canada:
Riley Engineering and Supply Co., Ltd., Toronto

Griscom-Russell
Heat Transfer Apparatus

Mention Where You Saw the Advertisement

"ZINCÖTING"

(*Coating with Sprayed Molten Zinc*)

with

METALAYER

will protect your Steel Equipment from Atmospheric Corrosion

ZINCÖTING is the word which designates the *application of molten zinc, in sprayed form, to any surface, by the* "METALAYER *Tool Only.*" Whether its an Oil Storage Tank, a Ship Auxiliary or part, a Tank Car, Steel Tower, a Bridge, a Street Lighting Standard, a Fire Plug,—whether it's steel or iron part exposed to *Atmospheric Corrosion,* —it can be *coated with molten zinc for permanency by* METALAYER — The "Putting on Tool."

Send for our New Catalog.

—use the Coupon.

METALS COATING CO. of AMERICA

495-497 N. 3rd St.—Philadelphia

CHICAGO CLEVELAND LONDON PRAGUE BERLIN HAMBURG

Gentlemen:

Please send me your New Catalog.

Mr.....Title.....

Company Name.....

Street.....City.....State.....

R-10

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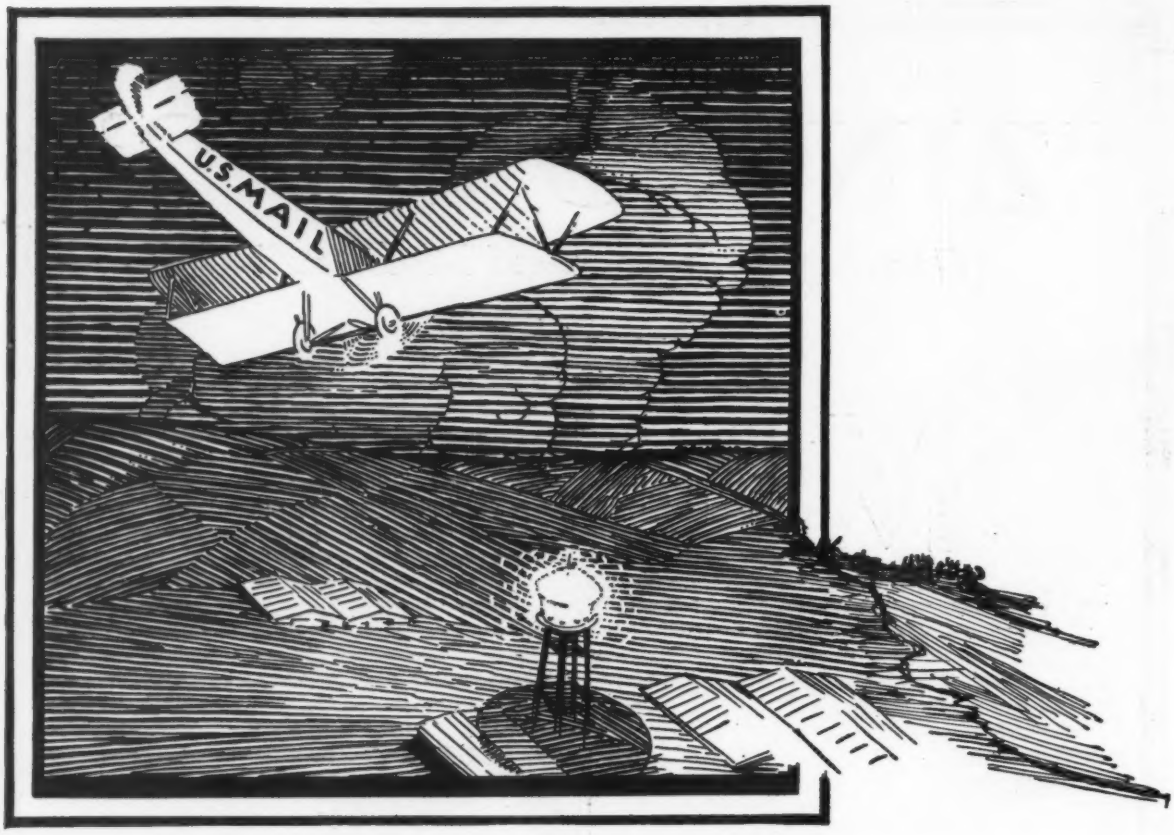


Chicago Tonight—New York Tomorrow Morning

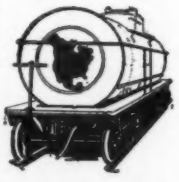
The message that you drop into the red and white and blue mail box tonight is whisked on wings of the wind for New York delivery tomorrow morning! Cities once separated by weeks are now but a few hours apart.

In marveling over this miracle, don't overlook one fact: air mail is carried in planes operated not by the government, but by private corporations under government contract.

Why? For the same reason that even some of the biggest shippers prefer car leasing to *car ownership*.

The airplane companies are specially fitted by training, organization and equipment to carry air-mail dependably and economically. North American Car Corporation is specially fitted to furnish advantageous tank, refrigerator and Palace poultry car service because all its energies are concentrated in that direction. Its shops are specially equipped to keep its cars in first-class condition. Its personnel is trained in the highly specialized business of car ownership and maintenance. Its special facilities, offered in conjunction with leasing service, are all the result of years of close contact with shippers' requirements.

The result is that the shipper gets the advantages of car ownership without the disadvantages and at minimum cost. He has no seasonal idleness of expensive equipment, no taxes, no depreciation charge-offs, no heavy investment in car equipment.



A letter from you will bring full details of the practical services offered to shippers by this corporation.

NORTH AMERICAN CAR CORPORATION, Executive Offices, Chicago, Ill.

Car Shops: Chicago, Ill., Coffeyville, Kans., Tulsa, Okla., North Judson, Ind. Bulk Oil Warehouses, Chicago, Ill., Tulsa, Okla.
Export Terminal: New Orleans, La., Galveston, Texas

North American
CAR LEASING SERVICE

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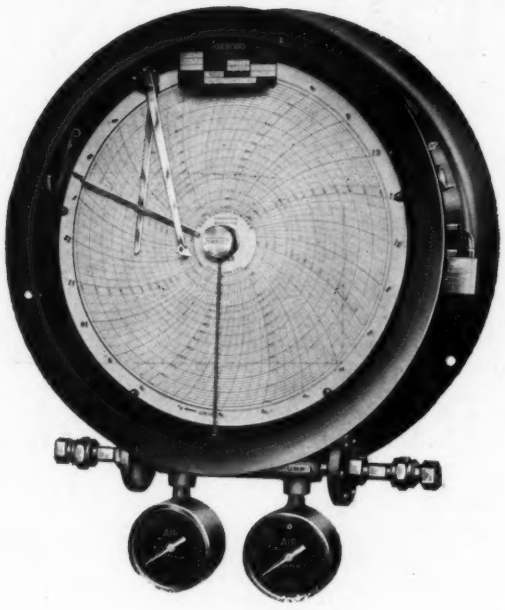
FOXBORO AUTOMATIC TEMPERATURE RECORDER-CONTROLLER



Performance Proves It

The value of Automatic Control of still temperatures has been demonstrated so conclusively that the problem now is largely a matter of what instrument.

You can't go wrong with a Foxboro Automatic Temperature Recorder-Controller. Thousands of these instruments control critical processes in hundreds of industries all over the world.

The direct-set, air-actuated principle makes their action positive and simple. *Just set the control lever and the temperature is automatically held at the exact degree without juggling or manipulation.*

Foxboro Automatic Temperature Recorder-Controllers are guaranteed permanent in calibration and are accurate to within less than 1 per cent of total scale range. The Foxboro national reputation for accuracy and dependability should be taken into consideration when deciding the important question of Still control. Foxboro engineers are at your service.

The Foxboro Co., Inc.

Neponset Avenue, Foxboro, Mass., U. S. A.
205 So. Cheyenne Avenue, Tulsa, Okla.

NEW YORK CHICAGO BOSTON PHILADELPHIA PITTSBURGH CLEVELAND ROCHESTER ATLANTA
LOS ANGELES SAN FRANCISCO PORTLAND, ORE., DETROIT

PEACOCK BROTHERS, *Limited*
1605 Delorimier Avenue
Montreal, Canada

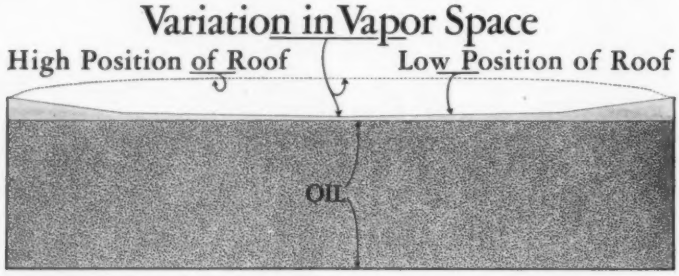
Sole British Representatives:
WALKER-CROSWELLER & Co.
58 Queen Elizabeth Street
London, S. E.

FOXBORO
REG. U.S. PAT. OFF.
THE COMPASS OF INDUSTRY

Instruments for Indicating, Recording, Controlling Temperature, Pressure, Humidity and Flow

A TANK ROOF FOR EVERY CONDITION

The new Wiggins Breather Roof supplements the well-known Wiggins floating type.

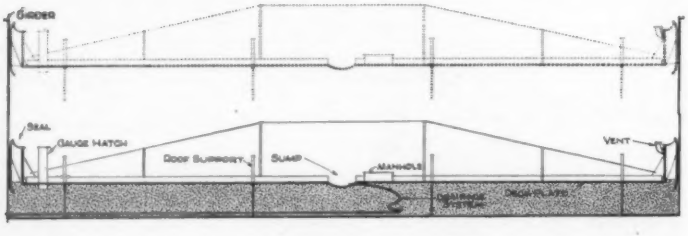


WIGGINS *Breather* ROOF *for standing storage*

THE Wiggins Breather Roof flexes up and down like a diaphragm. As the temperature rises during the day, the volume of vapor increases and the roof rises. As the temperature falls at night, the vapor contracts and the roof settles down to its lower position. On an ordinary 80,000-barrel tank with 1 foot outage this roof movement provides for a 33% increase in vapor space—ample to meet the expansion due to change in temperature from day to night. The tank will therefore allow no oil vapor to escape and no fresh air to enter, except at long intervals when seasonal changes covering a wide range of temperature are taking place.

This roof was thoroughly tested in an experimental installation presenting conditions more severe than in actual service. As a result of the success achieved with this roof, an actual field installation was made on an 80,000-barrel tank. Records made on this installation prove the magnitude of the savings effected by this roof. It solves the evaporation problem for standing storage, the first simple economical solution ever offered.

WIGGINS *Floating* ROOF *for working storage*



The Wiggins Floating Roof rests directly on the surface of the oil, with the narrow space between roof and tank shell normally sealed gastight. It rises and lowers as the oil level varies, never allowing any air space between oil and roof. This meets the requirement of a working tank perfectly. At much less cost and trouble than by recovery systems, the Wiggins Floating Roof eliminates practically all evaporation in this class of tanks.

Let our nearest office send you further information on the application of these companion roofs.

CHICAGO BRIDGE & IRON WORKS

Chicago: 2463 Old Colony Bldg.
New York: 3102 Hudson Terminal Bldg.
Cleveland: 2234 Union Trust Bldg.
Dallas: 1655 Dallas National Bank Bldg.
Atlanta: 1046 Healey Bldg.
San Francisco: 1051 Rialto Bldg.
Havana, Cuba: Apartado 2507.

Mention Where You Saw the Advertisement

The trend of the Natural Gasoline Industry is toward

portable equipment,

which makes the Charcoal Process of Gasoline Recovery the logical process to install. The simplicity of the equipment used in charcoal Plants makes them naturally portable.

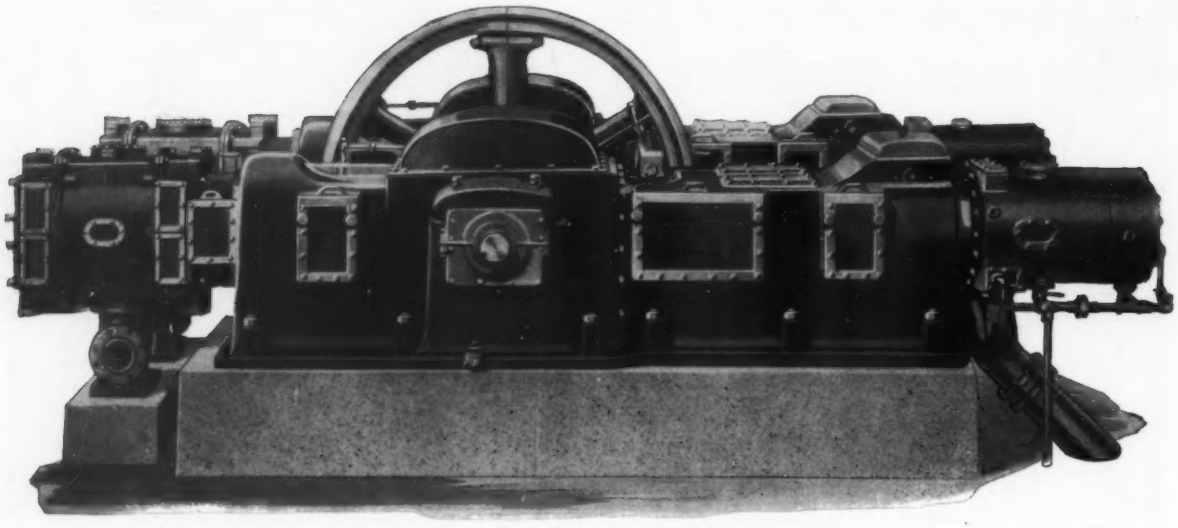
Use the process that does not sacrifice efficiency to gain portability.

CHARCOAL
PROCESS OF GASOLINE RECOVERY

GASOLINE RECOVERY CORPORATION, *Charleston, W. Va.*

TULSA, *423 Wright Bldg.* LONG BEACH, *Box 321*

Mention Where You Saw the Advertisement



Their Performance is a By-Word

BESSEMER
Gas Economizer

4 cycle gas consumption with 2 cycle simplicity.

The Bessemer Gas Eonomizer cuts 2 cycle fuel consumption to that of a 4 cycle—yet retains all the sturdy simplicity of the 2 cycle power plant.

This development, the experimental work on which has been carried on by Bessemer engineers for the past four years and is now perfected and available to the operator, is a simple mechanical device which injects the fuel gas into the combustion chamber under pressure.

It is a simple, mechanical attachment that gives the 2 cycle power plant the gas economy of a 4 cycle.

WHEREVER they are, whatever work they may be doing, Bessemer Type Tens are known—and noted—for their outstanding performability. Cold facts alone have established Bessemers as the standard of compressor service.

High compressor and mechanical efficiency, staunchness of construction, easy accessibility, outstanding simplicity, low operating and maintenance cost and their utter reliability are all factors that have made Bessemer Type Ten performance a by-word wherever the oil industry uses compressors.

Bessemer serviceability is being unceasingly demonstrated in thousands of installations —in natural gasoline plants, on air-gas lift work and in booster stations. They offer the greatest dollar value, the greatest security for any compressor investment, and incorporate the most progressive engineering features.

See them in action—look over their performance records—then judge for yourself

THE BESSEMER GAS ENGINE COMPANY
18 York Street :: Grove City, Pa.

BESSEMER

BESSEMER OIL FIELD ENGINES – COMPRESSORS **VACUUM PUMPS – ROLLER PUMPING POWERS**

Mention Where You Saw the Advertisement

The Holmes-Manley *Cracking* Process

Flexibility of Operation.

High Yield of Quality Gasoline direct from the Unit.

Fractionation and Condensation under Full Operating Pressure.

High Yield of Liquid Products with a minimum yield of fixed gas and carbon.

Low yield of Residue Fuel Oil of good Quality.

Relatively low Operating Temperatures.

Ease of Control.

Long Runs and High percentage of Operating Time.

Low Labor and Fuel Costs.

Address Inquiries to

THE TEXAS COMPANY

W. S. S. RODGERS

17 Battery Place, New York, N. Y.

Branch Office

816 Palace Building, Tulsa, Okla.

What makes a Balloon burst?

The billions of bubbles in a Campbell Absorber are really billions of tiny balloons, under pressure, constantly distorting, rubbing against one another, bursting and remaking. This agitation continues throughout the tower, intimately exposing gas to oil film. There are no dead areas, no channeling. By the time the wet gas has traveled through the sixteen individual pools in continuous contact with the absorbing oil, the gasoline has been thoroughly extracted.

J. A. Campbell

Consulting—Designing—Constructing

Natural Gas Engineer

P. O. Box 669 LONG BEACH, CALIF.

CAMPBELL

OIL FROTH

absorber

Mention Where You Saw the Advertisement

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

MARKETING CONDITIONS
AND
CRACKING OPERATIONS

As market conditions shift the operator of a Jenkins Cracking Process can vary his operation to suit conditions which give him the greatest percentage returns.

Crude
Topped Crude
Gas Oil
Residium

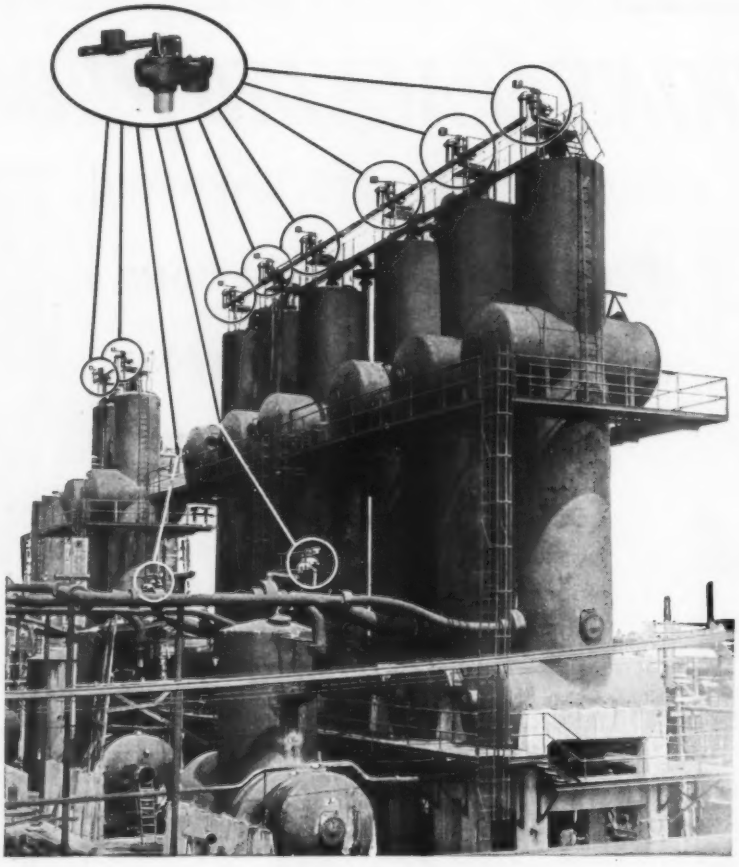
are all equally adaptable as a charging stock for the Jenkins Process.

GRAVER Corporation Founded 1857
EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO Steger Building | TULSA Atlas Life Bldg. | HOUSTON West Building

Write any office for descriptive bulletin

Modern Safety Valves for Modern Stills



A FEW years ago refiners *could put up* with old style still safety valves because conditions were not as severe as today.

Now, pipe stills and modern distillation apparatus demand something better.

For the past five years OCECO Still Safety Valves have been successfully meeting these modern conditions because in *design, material* and workmanship they have been *built* to meet them. Sizes up to 8 inches; pressures up to 30 pounds.

Send for catalog now. You will be interested also in Oceco Look Boxes and Automatic Tar Plugs.

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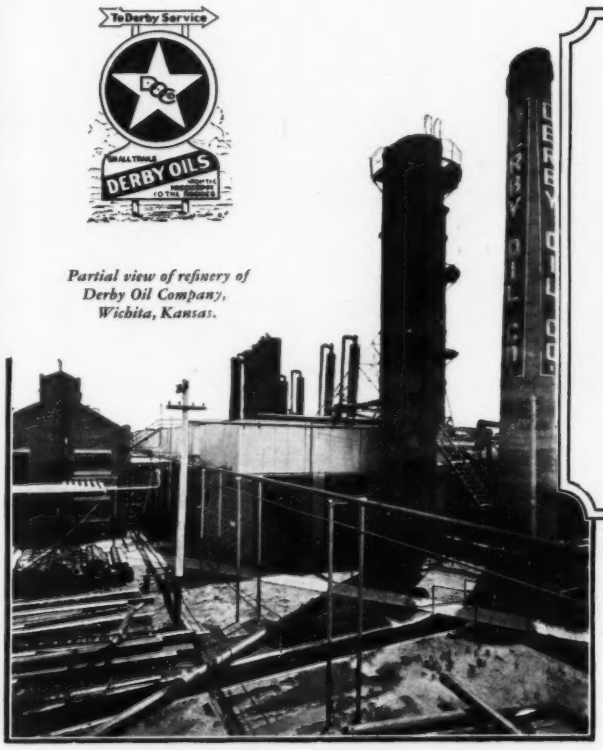

Partial view of refinery of Derby Oil Company, Wichita, Kansas.

A hook-up of Sterling Condensing Sections with the cooling sections.

AT the refinery of the Derby Oil Company, Wichita, Kansas, each of a group of six condenser boxes contains approx. 2800 sq. ft. of plain, ordinary condensing surface. As usual with this type of equipment the box space is entirely occupied—and every superintendent knows how many hours of labor are required to let a man down into the box for replacements, adjustments, etc.

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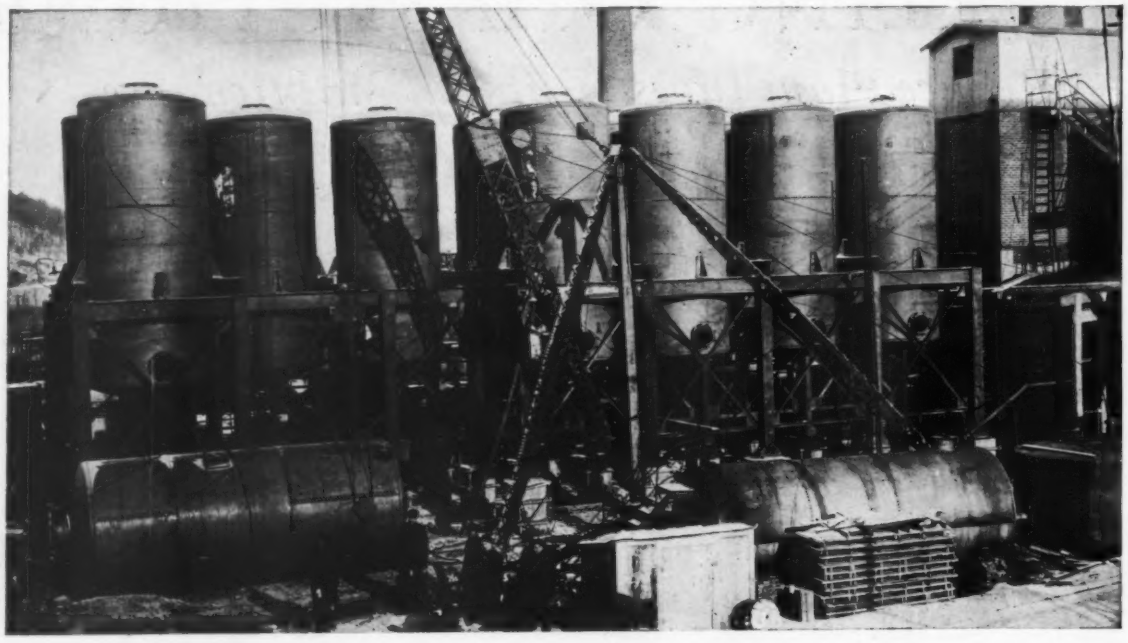

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Vol. 6, No. 10

OCTOBER, 1927

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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Who Makes Your Prices?

RECENTLY this writer sat for an hour and a half across the desk from the sales manager of a Mid-Continent refining company. In that time nine telegrams reached that sales manager.

He passed each across the desk and price was not mentioned in any case. Each asked that a car of gasoline of certain specification be shipped a certain date.

So far as the sales manager knew, neither of these customers knew the price of gasoline that day. The customer was ordering a certain gasoline for a certain date. Experience taught each buyer that the gasoline would meet the required specification and that it would be shipped the date requested.

That hour and a half was typical of orders to this concern. Its customers want a product of definite quality on a definite date. With them price is secondary.

The contrast of this condition with that prevailing in the independent refining industry is pitiful. The difference is the flag that tells of the plight of the average refiner.

Most all gasoline is sold on price as the first consideration and it is not the refiner's price. Tank car gasoline prices are made by the buyer and not by the maker and seller of gasoline.

While this writer has no contrasting hour and a half to offer, he has seen so many other gasoline orders by telegram that this is offered as the method by which most gasoline is bought. The refinery sales manager receives a wire to the effect that gasoline has been offered at a certain price. Always the price is below the refiner's quotation. All too often the sales manager goes into consultation with other executives and the order is accepted at the lower price, specification and shipping date secondary.

Gasoline from independent refiners is being sold at prices made by the buyer. Often the buyer has not been offered gasoline at the lower quotation. But the jobber knows the habit of the office from which he buys. He knows that organization will meet a lower price.

Even where the jobber has another lower price offer, the refiner is making equally as serious a mistake in meeting the lower price. The refiner who continues to sell at prices fixed by the users of his product continues to hover near the line where losses begin. No buyer is going to leave a profit if he can draw prices below the line.

If the ranks of the independent refiner need anything it is a determination to sell at prices fixed at the source of the product, rather than at the source of consumption.

Neither is it enough to wail that such is impossible. The one concern above mentioned is not the only one maintaining its own prices. There are other refineries in that class, although they are all too few.

Outside the oil industry prices are commonly fixed by makers rather than users.

If it can be done by a few refiners and by manufacturers of other commodities, it can be more widely done by refiners.

The refiner needs backbone. When he gets a spinal column that can hold his head up long enough for him to say "NO" he will stand a chance for profit.

Grady Tippett

The illustration shows Getty Gasoline Company's new gasoline plant, containing four Cooper Type-80 single gas engines in the Long Beach, California, field.

Getty Gasoline Chose Coopers

This is another example of where the purchaser believes that the best machinery obtainable always proves cheapest in the long run.

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Making It Safe for Safety

In the Marland refinery the gangs have adopted the program instead of listening to it. The safety department has lost only banquets so far

By GRADY TRIPLETT

IT started when some man in the insulation crew or some man in the fire and clean-up gang decided his crew could go 90 days without a lost time accident. The reason for saying it was some man in one of these crews is that the writer failed when over at Ponca City to learn just which crew issued the challenge.

Anyway, the first thing the Safety Department of the Marland Refining Company knew of the contest was that these two crews of the refining plant were in competition as to safety. One crew issued the challenge and the other promptly accepted.

The important part of the whole thing is that safety through this competition took a new turn in this company and it has been growing since. The result is that accidents are fewer and more men are working to prevent accidents.

Here was the condition as Ray Miller, director of safety, learned it. The insulation gang and the fire and clean-up gang started January 1, 1927, to see which would have the best score on accidents for 90 days. The losing crew was to banquet the winner.

Both Won

It was new. So it drew a lot of attention. The result was that April 1 came up on the calendar and there had not been a lost-time accident in either gang. Neither had lost. Each had won, but there was no banquet in sight.

So the safety department came in and furnished the banquet. Members of each crew, involving 50 men, were on hand to eat at the expense of the safety department.

Long before the first competition in safety had reached the banquet stage, other crews in the plant were anxious to match efficiency with some other gang. After the banquet the utility gang was ready to take on the fire and clean-up crew. The insulation gang found competition in the pump repair gang. This brought more than 100 men into the two contests.

These ran for three months, and like the first competition, no lost time had been charged to accidents in either of the four crews. So it was up to the safety department to come to the rescue with another banquet, members of the four gangs being the guests.

The Longer the Bigger

And the competition in safety kept growing. The labor gang took on the pipe fitters. This brought from 80 to 100 men under an intense influence of safety. When this was written there had not been a lost time accident in this competition.

Also with the first of July a three-way contest was put in force to run six months. This involves the light oil, the lubricating oil and the pressure still crews into competition. Late in September there had been just one accident in these three gangs, which average 250 men. Outside the refinery some field crews of the Marland Company are opposing each other in safety competition. The first crews to take up the competition have decided that it is no longer necessary to be in competition in order to be free from accidents. The insulation gang conducts a continuous safety campaign within its ranks. Its members are constantly looking for hazards, knowing they will be rewarded if hazards are found, or penalized by demerits, if safe practice is not maintained.

"All this has just turned safety around," is the way Ray E. Miller, safety director of the Marland companies, explained the benefits of those competitive moves originated by the working crews.

"Instead of workmen," he continued, "being the marks for safety talks and warnings, the workmen have assumed the place of a supervisor. They have adopted safety instead of listening to safety. And the results of these contests show that the adoption of safety is the better method."

One Gang's Way

If a stranger should happen along at noon where the insulation workmen of the Marland plant are eating lunch, he might mistake the gathering for a mock court. What he would see would be a man reporting some condition he considered unsafe for workers. When he had finished, the crew would take a vote. If the vote favored the workman, the unsafe condition would thereby be condemned while the man finding the condition would be awarded a certain number of merits for his alertness.

But let some member of that crew drop a hammer without first looking at the ground and calling "look out below," and the scene the visitor might witness would be different. It would be like a mock court. For that sort of an act would result in charges being preferred by other workers. Unless the workman decided to plead guilty, he would be tried and demerits put opposite his record, if found guilty.

As an instance of the way this crew is looking to safety, consider this condition. Two members of the crew, while leaving the plant after shift, passed a board having an upturned nail. The board was not in their path, but within their vision. They passed it by. Some other members of the crew following saw the board and noticed that the two men failed to turn the nail downward.

Self-Made Rules

So that was reported the next day at the noon meeting around the lunch pails. The two men finally were cleared of any omission of duty, since they were off duty and on their way from the plant. But the case was prosecuted.

This continued interest in safety by the insulation gang is the result of the two competitive periods it went through without an accident. When the crew got into competition it was realized that its members should never forget safety. So the daily meetings were devised. Out of these grew the following rules and regulations under which the crew continues to conduct itself:

"We, the workmen of this department, have decided that owing to the 90-day no-accident contest which we have entered, that it is necessary for us to unite in a combined effort to eliminate every accident which is caused by workmen taking chances.

"First, each workman will be given 100 merits, from which will be deducted or added to, according to his ability.

"We understand that the beginning of real practical safety is for every workman to be wide awake and alert at all times to the ever present chance of danger to himself and fellow workmen. Therefore, any workman who by carelessness or failure to make a job safe, shall be deducted not less than 10 merits nor more than 50.

Rules Governing Workmen's Council

"The amount of demerits given to the guilty workman shall be governed by the Workmen's Council, which shall consist of the entire department.

"Each workman, when charged with some offense, shall plead his own case. He may call for witnesses from any source.

"One man's testimony shall not be taken against another. There must always be two witnesses, who will swear to having seen the condition under which the workman is being tried.

"Where two men are working together and one of them shall become careless or fail to work safely, the other workman shall report the same to the council at the first opportunity.

"Then the council shall endeavor to get him to plead guilty. If he insists that he is innocent, the case shall be dropped.

"But if he pleads guilty to the charges brought against him, he shall be fined by

the council according to the nature of the charge.

"But for his honesty and willingness to take penalty to help safety become a reality, he shall be given an honor mark which shall show to his fellow workmen that he is an honest, right-thinking, straight-shooting sort of a fellow.

Rules Governing Demerits

"These are some of the most hazardous things we have to deal with. Therefore, we will try and get them before us so it will cause us to think about them.

"1. Any workman who is seen walking over loose boards with nails in them, or walking on pipes, or any such thing that, will cause him to take a chance, shall be given not less than two demerits nor more than 10.

"2. Men working on scaffolds must see that they are safe before going on them. Somebody else's carelessness may cost you your life. All material not being used on scaffold must be sent down, such as loose boards, wire, buckets, etc.

"3. Any man who will allow himself to become mad to the extent of temporary insanity and demonstrates the same by kicking buckets from scaffolds or by throwing tools shall be tried and fined not less than 25 demerits nor more than 50.

"4. Any man caught scuffling on scaffolds or taking an unnecessary chance shall be given a stiff penalty.

Rules Governing Merits

"1. Any workman who sees a possible chance of an accident, shall report the same to his foreman. Then the foreman shall look the job over and if he decides it is unsafe, the workman shall be given as many merits as the council may agree upon.

"If the foreman thinks the job is safe and the workman is not satisfied with the decision he may call for the opinion of his fellow workmen. If still unsatisfied, report it to the safety department.

"If a workman uses his head and sees a way of making a job safer, and the foreman accepts it, he shall be given not less than two merits nor more than 10.

"These rules may be added to as the need may arise.

"This is a 90-day no-accident contest among the insulation boys. At the end of 90 days the man having the largest per cent shall be given a reward for his efforts. Each man will be required to put in as much as a dollar.

"Yours for no accidents,
"Insulation Boys."

Safety in Boiler Operation

*By L. L. BAKER**
Superintendent of Power at the Barnsdall Refinery

1. The first act of the engineer on entering his watch is to ascertain the exact height of the water in his boilers. Do not rely on glass gauges, floats or water alarms, but try the gauge cocks. If they do not agree with the gauge glass learn the cause and correct same. No engineer should be satisfied with a general squint at the gauge glasses, but should satisfy himself that the water is normal, for insurance companies tell us defective gauge glasses and cocks and stopped-up water columns are the cause of more boiler failures than all other causes combined.

2. Low Water—In case of low water immediately get fire from boiler and under no circumstances try to put water in same, lift safety valve or start up any load on it until it has been cooled down to zero pressure and its condition ascertained.

3. Feed Pump on Injector—These should be kept in perfect order and of ample size. No make of pump can be expected to be reliable without regular and careful attention. It is much safer to have two means of feeding boilers. Check valves should be frequently cleaned, so that they will function when pump or injector is not working.

4. Fusible plugs must be examined when the boilers are cleaned and carefully scraped clean on both the water and fire sides, or they are liable not to act in case water goes off crown sheet.

5. All heating surfaces should be kept clean outside and in or there will be a serious waste of fuel. The frequency of cleaning will depend upon the nature of the fuel and water, but good practice demands a weekly cleaning in most cases.

6. Safety Valves—Great care should be exercised to see that these valves are ample in size and in working order. They should be tried at least once every day to ascertain their true conditions.

7. Steam Pressure Gauge—This gauge should be tested once a month against a standard gauge and under no circumstances should an inferior gauge be used for this purpose.

8. Never pump cold water into a hot boiler. Many times leaks and explosions are caused from this practice.

9. If water is muddy or salty, blow off a portion frequently, according to condition of water. This is sometimes necessary six or eight times a day.

10. "Cutting-In" Boilers—To cut-in a boiler or put it "on the line" after it has been out of service, is to place it in free communication with other boilers that are under steam.

In cutting-in a boiler that has been idle the stop valve should be kept closed until the steam pressure in the boiler has risen to the exact value that is prevailing at the time in the steam header, to which the boiler is to be connected. It is not correct to bring the pressure to within a few pounds of that in the main.

Practice of this kind should not be used for it is very important that the pressures should be exactly the same, or as near the same, as the different gauges indicate. When the gauges indicate the same the boiler stop valve should be opened very slowly by a mere crack at first, because it will be impossible by means of commercial steam gauges to get the pressures exactly the same, so there will be no flow in either direction, but when the valve is opened very slowly it permits the small outstanding difference of pressure to become equalized gradually.

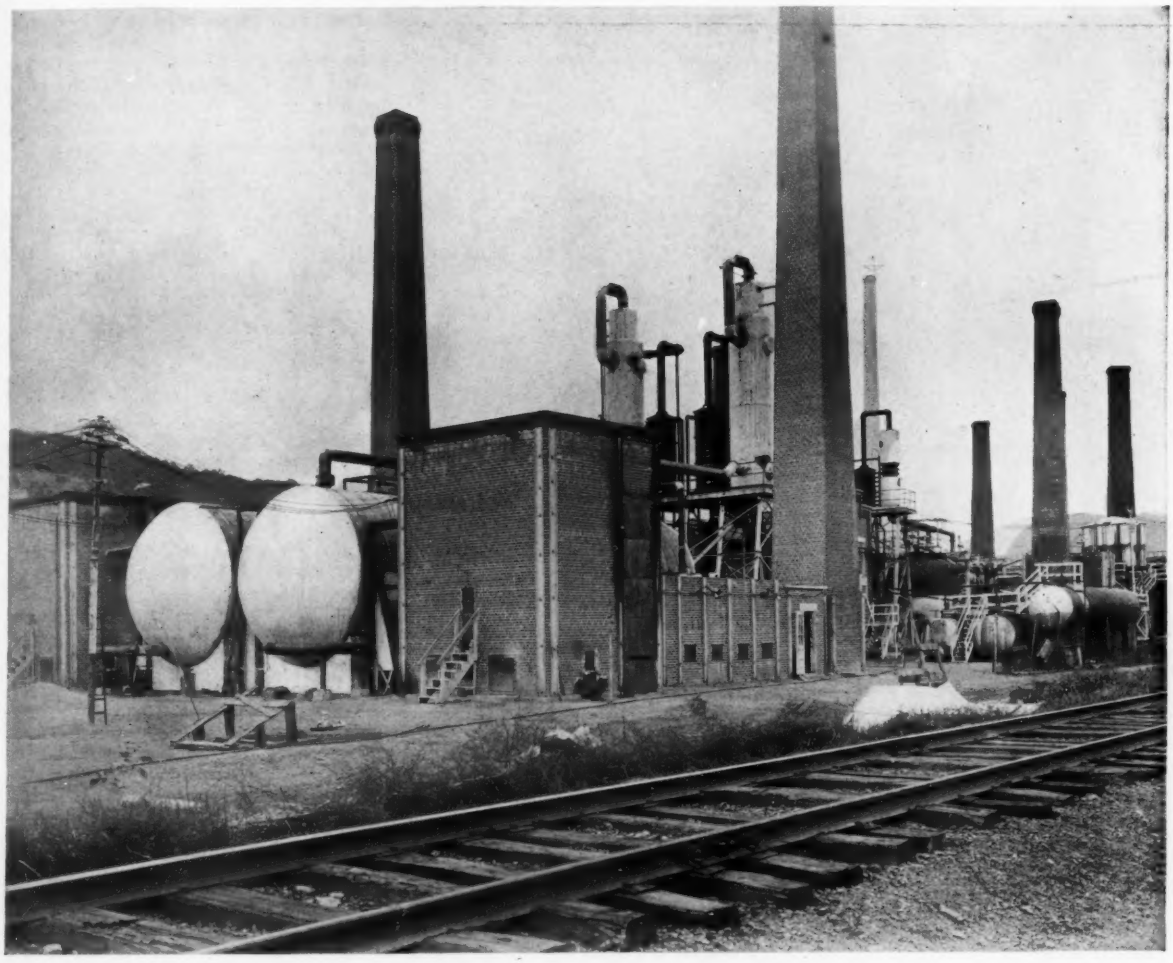
If there is any evidence of disturbance on the boiler or piping, as indicated by snapping or pounding, or by abnormal vibration of the boiler, the stop valve should be immediately closed. If there must be a difference of pressure it is safer to have the pressure in the boiler to be cut-in a little higher than pressure in main rather than lower, because steam will then flow from the boiler out into the main instead of the opposite direction. However, it is much better to have pressure as near equal as possible to do so with commercial gauges.

*Reprinted from the Barnsdall Magazine, September, 1927.

New Process Installed in Panhandle Plant

Amarillo, Texas.—The Sobri Company of Brussels and New York has begun construction of its natural gasoline plant in the Panhandle, Texas. Location of the plant is southeast corner of section 21, A & B survey, Johnson-Prairie lease. Phillips Petroleum Company will supply the new plant with low pressure gas, around three-fourths of a pound, which contains around one-half gallon per thousand cubic feet.

This plant is of a new type for this country, being designed by J. H. Bregeat, one of the leading French scientists in the solvent recovery industry. Tetrahydro-naphthaline, under its commercial name of tetraline is to be employed as the absorbing medium instead of the usual absorption oil. Through the use of tetraline, it is unnecessary to compress the gas treated for the purpose of removing the gasoline content. This installation will be the first instance of use of the tetraline process in the United States. The initial capacity of the plant under construction is to be 5000 gallons daily. Dr. E. Kroch of the Sobri Company has charge of the installation of the equipment.



Distillation equipment consisting of tube still and shell type separator employed by the Emery Manufacturing Company, Bradford, Pa. Hook-up of fractionating equipment also shown. To the right is shown the type of absorption tank vapor recovery system as described. The stack in the back-ground with the flag flying, just after completion, is 235 feet in height, and built for the new power house under construction.

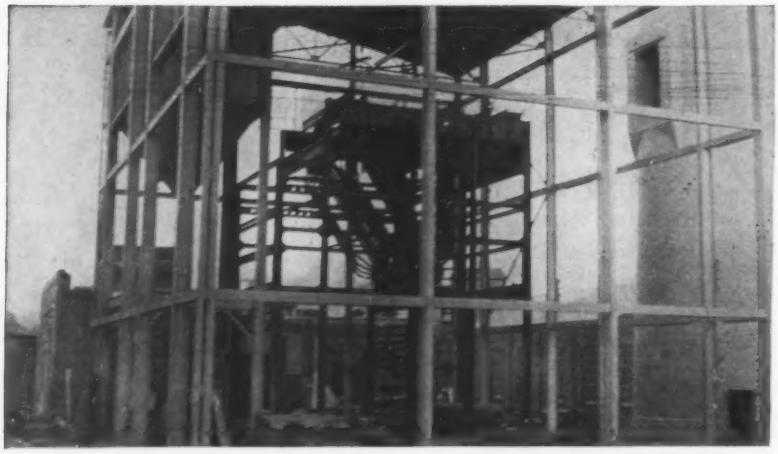
Emery Plant Successful With Tube Still Distillation on Pennsylvania Crude

By GEORGE REID
Associate Editor

FOR the past three years the Emery Manufacturing Company, operating its Bradford refinery has been successfully employing tube still distillation methods in the refining of Pennsylvania crude. This company numbers among the first to operate a unit of such type in western Pennsylvania, and since its original installation of two units in 1924 has during the past year installed two additional tube still units of larger capacity. The experience of the Emery Company has removed all doubt as to the success of employing tube still procedure in the refining of Pennsylvania oils.

The units operated by this company may best be termed "circulating pipe-shell stills," since both types of stills are employed. The system of distillation employed is the design of Alexander Lackman, superintendent and research engineer for the Emery organization, who has carried on a great deal of investigation as to the adaptability of the high efficiency of the tube still to the problems of refining Pennsylvania crudes. His first installation, which has been in operation three years, was decidedly successful, and was followed by the newer and larger units recently installed, and which will be briefly described at this time.

The larger units consist of a shell still, 52 feet long by 16 feet in diameter, well insulated and having a capacity of 2000 barrels. The shell still is directly connected to a tube still, through which the oil is circulated from the shell still and returned it. In operation the shell still is first charged with crude. Fires are started under the tube still and the circulating pump is started. This pump is a six-inch Viking centrifugal, driven by General Electric 40-horse power motor. Suction and discharge lines are six-inch. The pump takes suction from the shell still and discharges into the tube banks in the tube still, rising upward from the bottom tube bank in the cooler zone, to the uppermost tube bank in the zone of highest heat, to be conducted back into the shell still. Oil entering the shell still is released into the large body of oil through a hoirzontal line at the bottom of the shell, in the bot-



View of Emery Manufacturing Company's new Erie City three drum boiler under construction. There is ample space left for the installation of another unit when required. This will be the first power plant in the Pennsylvania refining center to be automatically fired with powdered coal.

tom of which line there is a great number of very small perforations. Thus the heated oil is caused to bubble upward through the large volume above it, to impart some of its heat and to become intimately contacted with this oil. That portion vaporized by the application of heat during circulation in the tubes, rises through the oil, being scrubbed slightly as it ascends, and these vapors are conducted from the shell still through two large vapor lines leading to Southwestern type bubble towers, equipped with cooling or control section on the top, and through Southwestern condenser sections to the receiving house.

As the oil is circulating through the tube banks at a rate of about 700 gallons per minute it gradually rises in temperature and with each circulation more of the lighter portions are vaporized and conducted through the vapors lines, dephlegmators, condensers and to the receiving house and storage. In this manner all of the gasoline, naphtha and kerosene is distilled. Some steam is used in the shell still section of the unit, but no fire. The maximum temperature employed is around 470 degrees Fahrenheit for the removal of 46 to 48 per cent of the crude charged to the unit.

Both the smaller, 1200 barrel, units and the new large installation are double units, consisting of two pipe still and two shell stills, which are operated alternately and batch. The larger units handle about 1800 barrels of crude each 48-hour run, and the entire charge of 1800 barrels is circulated through the tube still in one hour and a quarter, which time gradually decreases and the volume becomes lessened, due to distillation.

The original twin installation displaced six shell stills and made it possible to increase the monthly crude runs from around 34,000 to 48,000 barrels. The time required to run down a given volume of crude was reduced about 50 per cent. The operation of the present equipment has brought about the elimination of re-running, and the yield of gasoline recovered from the crude has been materially increased, with only the one heating. In addition the plant is producing a finer quality of cylinder stock than was possible under the older methods.

Between the condenser boxes and the "look box" the condensed liquids are passed through a three-foot by eight-foot separating chamber, in which the water resulting from steam insertion in the shell still is accumulated at the bottom and removed by automatc liquid level control—the gasoline is taken from the middle section to the receiving house and the uncondensed gases are removed from the top. These gases are conducted to the "absorption tanks," which contact with naphtha causes the absorption and removal of the valuable gasoline vapors. There are three absorption tanks, one for each tube still unit and one common tank for both units. The capacity of these tanks is 150 barrels.

The gases enter the first tank, filled partially with naphtha, through a line just above the bottom of the tank, which is finely perforated and the gas bubbles upward through the naphtha. Vapors from this first tank are conducted to the second, where the operation is duplicated, and the gasoline content of the vapors is removed. Waste gas from the second tank is burned under the stills.

Usually the distillation of two batches of crude and the absorption of gasoline from the uncondensed vapors thus secured will cause an increase in gravity in the naphtha used as the absorbing medium of from 52 to 57-58 degrees A. P. I. This gasoline is then pumped from the tanks and blended with the straight run products, or marketed as a blend to specifications.

In operation of the circulating shell-tube still units distillation is effected at comparatively low temperatures and with no injury to the crude so far as its subsequent distillation for lubricating oils is concerned. When the charge of oil is entirely stripped of the lighter portions of gasoline, naphtha and kerosene, the still is permitted to cool somewhat and the bottoms are transferred to the battery of shell stills. The subsequent distillation of this oil yields the gas oil or fuel oil fraction, the wax distillate and cylinder stocks, which procedure is carried out in the usual

With the recovery system as described in operation virtually all of the recoverable gasoline is secured and with the closed system of operation the refining loss is negligible.

In addition to these features there is that of the installation of waste heat boilers in the flues of the two new combination pipe and shell stills at this plant which is of importance and very interesting. These boilers, which were designed and placed in operation by Mr. Lackman, made it possible for the manner.
company to operate during the past winter without the installation of additional power plant equipment.

(Continued on page 118.)

Showing details of construction of the waste heat boiler installed in the flue passage between the tube still and the stack. This boiler generates more than sufficient steam for the operation of the unit, include the use of steam in the shell still type separator.

Treatment of Light Oil Products

By A. HENRIKSEN
*Chief Chemist, Marland Refining Company**

THE refining of gasoline is a difficult problem due to the variations in the quality of Mid-Continent and West Texas crudes and the recent developments in refining methods, particularly the cracking of high sulphur crudes. To meet these problems it has been necessary not only to carry on considerable experimental work, but also to maintain strict control and inspection after the experimental methods have been applied to the operations on a plant scale. Especially in regard to control and inspection may be mentioned the necessity of segregation of stocks as they are sweetened; and also the accurate control of the application of doctor solution and sulphur in order to produce a gasoline of good stability to sunlight and negative corrosion. It is interesting to note that upon distilling some crudes, free sulphur is found in the gasoline and has a decided influence in the sweetening action.

It can be definitely stated that through careful control by the laboratory, it is possible to reduce the cost of refining, improve the product from the standpoint of corrosion, stability of color, saving of chemicals used, and to insure absolute uniformity of product. In addition to the laboratory control of the treating process it is advantageous to also control the distillation and fractionation processes scientifically.

The Plumbite Method

The Plumbite method is one with which you are all familiar because of its general usage. There are several different types of equipment which may be used; continuous, batch, circulating; we use a batch circulating system, consisting of a cone bottom agitator equipped with a large draw-out line at the bottom connected with the centrifugal pump and mechanical mixers, from which a line leads back into the agitator near the top. The mechanical mixers consist of three 8-foot lengths of 24-inch standard pipe with heads and stuffing boxes on the ends, the whole resting in a horizontal position in a steel cradle. Each cylinder is equipped with a shaft to which are attached four, four-bladed propellers, similar to ordinary electric fan blades. The propellers are so mounted that the throw of the first is opposite to that of the second and the throw of the third is opposite to that of the fourth, thus giving the maximum agitation contact. The speed of the shaft is from 100 to 150 R.P.M. By means of this equipment, a certain percentage of both the doctor solution or caustic and gasoline is pumped through the mixer where a thorough contact is made. The entire quantity of oil can be circulated in a short period of time, depending upon the capacity of the agitator. (The paper on "Refining Panhandle Crude," presented by Mr. Walter Miller at the A. P. I. at Tulsa, December 7, 8, 9, 1926, gives a complete description of the above apparatus.)

In operation, the raw gasoline, after being charged to the agitator, is washed with caustic solution when considerable hydrogen sulphide is present. This removal of hydrogen sulphide saves the lead in the doctor solution which would otherwise be precipitated as lead sulphide. After withdrawing the caustic solution, the doctor solution is circulated through the system, the reaction being that the mercaptans are changed into lead mercaptides, which upon the addition of free sulphur will react or break down, giving disulphide or a gasoline sweet in odor and negative to doctor test, and lead sulphide. It is necessary to have sufficient sodium plumbite present to react with all the active mercaptans present in the gasoline to sweeten it quickly. The preliminary removal of the hydrogen sulphide has the following advantages:

(1) Decreases the quantity of lead required to sweeten.

(2) For a given solution of plumbite, the time required for the sweetening is reduced.

(3) A more accurate control of sulphur, and therefore, better corrosion test.

We have found two operating conditions which have an important bearing on stability and corrosion tests on the finished gasoline; these are:

(1) The necessity of agitators absolutely clean and free of lead sulphide, sulphur and other sludging materials remaining after previous treats. This can be prevented by the installation of suitable coils with which to wash the sides and cones with water.

(2) The guarding against the accumulation of sulphur bearing scale and sludge in the run tanks, as this will often cause gasoline to re-dissolve so much sulphur that the treatment cannot be controlled for corrosion test.

The Lead Sulphide Sweetening

The role that lead sulphide, or spent doctor, plays in sweetening is interesting. Lead sulphide that is suspended in a caustic solution in a current of air is slowly oxidized to lead sulphide, and thiosulphate and finally sulphate. These compounds are soluble in the caustic solution forming sodium plumbite and sodium sulphate. It is in this way that with the aid of considerable time and in the presence of oxygen, lead sulphide will sweeten the most difficult gasolines such as Amarillo. The lead sulphide apparently has a catalytic effect on speeding up the action of the doctor solution, and in addition absorbs and holds mechanically considerable quantities of mercaptans, which make it easier for the plumbite reaction to be completed.

The Reclaimed Doctor

By using the same principle as stated above, a very important method of preparing plumbite for sweetening is possible by making what we call a reclaimed doctor solution. The spent doctor solution containing lead sulphide suspended in caustic, is drawn from the agitator into a tank which is equipped with steam and aircoils. Compressed air passes through perforations in the coils at the bottom of the tank, thus agitating the lead sulphide and oxidizing it to lead sulphite, thiosulphate and sulphate, these compounds having been identified in the reclaimed plumbite solution. When the reaction is complete, the black solution will clear up to a colorless or slightly reddish color. The temperature is controlled by steam in closed coils and a maximum of 200 degrees F. is reached. The heat helps to oxidize and decompose sulphur and impurities, thus removing these harmful compounds, that are usually present in spent doctor. The doctor solution is now called reclaimed doctor and ready for storage until used. The properties of this solution are very similar and have the same effect upon gasoline as new doctor solution. The advantages derived from this process are numerous. There is a saving of chemicals, both lead and caustic. It may be used without endangering the chances of meeting corrosion test. Its action is as rapid as new doctor and the so-called lead sulphide break is better and settles even quicker than when new doctor is used. The color of the gasoline is not injured and the stability of the color in both sunlight and dark is as good as when new doctor solution is used.

The Laboratory Control of Sulphur and Doctor Solution

The entire reclaiming process is under laboratory control. It is a great aid to know the exact percentages of lead and caustic present in the doctor solution. A great deal of care is taken so that these percentages remain constant in the solution to be used at all times. This enables the treater to get more uniform results upon all batches of gasoline, in this way greatly speeding up the production and obtaining better products. If the gravity of the doctor solution is low (10-12 degrees Baume) with a definite small percentage of lead (0.8 per cent) the break or lead sulphide formed when the gosoline is sweet, will settle quickly and thor-

*Delivered at technical meeting of Western Petroleum Refiners Association, Hotel Lassen, Wichita, Kansas, October 11, 1927.

oughly, so that no final wash is necessary. In addition to this, laboratory control on the quantity of sulphur that is necessary to break out and sweeten the gasoline, enables the treatment to be carried on more efficiently. However, if hydrogen sulphide is present and lead sulphide or spent doctor is used, the quantity of sulphur required is much less, and in the plant, if these econditions are present, the decrease in the quantity of sulphur added must be governed accordingly. It is very difficult to know the sulphur necessary for various batches of gasoline unless the preliminary determination is made in the laboratory. The importance of the sulphur control is shown by the fact that with certain gasoline a few pounds of extra sulphur in a 1000-barrel batch will throw the gasoline off in corrosion test.

The Treating of Pressure Distillate

The problem of treating light products of cracking processes whether pressure or atmospheric, is one which has engaged the industry's attention for 20 or 30 years. Even before cracking became a factor in refining, a cracked gasoline and kerosene was made in the old coke still operation at atmospheric pressure, which in many respects presented problems harder to solve than in the case of products made under pressure. Initially, the cracked gasoline so made was such a small part of the total produced, and the specifications so liberal that it was not until the internal combustion motor came into fairly general use that much attention was paid to it. The main progress made in the airly days was developing the knowledge that a distillation of the products after acid treating was necessary to do away with excessive gumming tendencies. Incidentally, that fact is still apparently fundamental today because we know of no method of acid treating of cracked products which gives satisfactory results in this respect, without subsequent distillation or heat treatment of some kind. In other words, it was learned then that gums formed by heat in acid treated cracked products and that it was much cheaper to form these gums by heating in the refinery than to have them develop in the internal combustion motor, with the consequent difficulty of sticky valves, excessive carbon deposits, etc.

In the last few years, more particularly since the advent of the high temperature, high pressure processes and the newer atmospheric pressure processes, a great deal of scientific experiment and investigation has been carried out, and various methods of handling these products have been advanced from time to time. Many of these will occur to you, and all have been tried to a greater or lesser commercial extent.

There are various methods of treating pressure distillates.

(1) *Single plumbite method* in which the pressure distillate is acid treated, water washed, neutralized and sweetened with 10-12 degrees Baume plumbite.

(2) *The double plumbite method*—the distillate is first given a doctor treat, then acid treated, water washed and then neutralized and sweetened with 10-12 degrees Baume plumbite.

The distillates treated as above mentioned must be steam stilled in order to produce a sweet, stable product.

(3) It has been our experience that, if the distillate is lightly acid treated, water washed and neutralized with caustic, that a very stable product is produced, running through Gray towers on the re-run battery.

The pressure distillate is treated in a continuous system, composed of tanks or towers, where the various stages of the process take place, permitting a constant outflow of treated distillate. The first stage is the acid treatment with 60-62 degree sulphuric acid. The quantity used depends upon the stock used, usually varies from two to eight pounds per barrel of distillate. There are a number of mechanical methods and apparatus used for adding and mixing the acid with the distillate. The one used in this system is a small cylinder in which is suspended a propeller, which revolving very slowly, mixes the acid and oil. From the mixer the distillate is carried into a tall tank where the acid is allowed to settle out and is drawn off at the bottom. From here the distillate flows into another mixer like the first, and into another settling tower. Thus a thorough acid treatment is insured. Next, the distillate flows into the wash tower, where all the acid possible is removed by water washing, the water being sprayed from the top down through the upward moving oil and withdrawn at the bottom. In the next tower the distillate is given a good caustic wash with about 8 degree Baume caustic to neutralize any acid or acid-compounds so that the distillate on leaving is neutral and will be stable when stored.

The Gray Tower Process

The treated pressure distillate is now rerun in six shell stills equipped with Gray towers, in order to obtain the gasoline fraction. The vapors from all the stills enter a common header, in this way equalizing all the vapors going through the Gray towers.

The tower streams that drop back are used as reflux over the towers again. In connection with the re-running of pressure distillate, the Gray Vapor Phase method of treating oil has become very popular with the refiners in the last few years. This method consisting in treating the gasoline vapors as they come over from the still allows them to pass through 360-60 mesh Fullers earth. The action of the clay polymerizes some of the unsaturates and removes most of the color compounds and unstable compounds from the gasoline. These polymers collect and are continuously removed from the clay. The polymerization is about .5 per cent by volume of the total pressure distillate being run, or .8 per cent of the pressure gasoline produced. The polymer fraction is pumped back into the charging distillate so that all the gasoline is recovered. With proper control of Gray tower we are able to get 1800 barrels to 5000 barrels yield, depending on the number of times the clay has been burned.

The gasoline after the Gray tower treatment has a stability varying from 30 to 25 color during four hours sunlight.

Soda Ash Wash After Gray Towers

In connection with the finished gasoline from the Gray tower, another stage of treatment is employed. The streams of gasoline are washed with sodium carbonate solution as they go into the run down tanks. The result of this soda wash is to remove the sulphur dioxide from the decomposition of sulpho-compounds and alkyl-esters by the Fullers earth, before they have time to react with the highly unsaturated hydrocarbons and aromatic compounds. The sulphur dioxide in the presence of moisture forms weak sulphurous acid which will react with the unsaturated and aromatic compounds forming unstabic compounds. By the use of sodium carbonate the color stability of gasoline is insured as much as possible for both dark and sunlight tests.

In explanation it has been found that when raw gasoline, either from pressure distillate or straight run that has been immediately caustic washed, after distillation is subjected to sunlight if the color remains stable the sweetened gasoline will be also stable if sweetened correctly. Likewise an unstable raw gasoline gives an unstable sweetened product.

Vapor Phase Treatment of Cross Process Gasoline

Our Cross process equipment consists of two standard 2000-barrel per day units and three 19-ton Gray vapor phase treating towers. The Cross operation is practically standard, the bubble towers being controlled for end point gasoline. The gasoline vapors pass to the Gray towers, and down the bed of Fullers earth. The treated gasoline vapors pass from the bottom of the Gray towers to the condensers.

The Gray towers are 11 feet in diameter and 16 feet high. The clay bed is eight feet thick, thus allowing ample vapor space above and below the reaction zone. The average rate through the tower is 25 barrels per hour. The pressure drop through the clay bed is three and one-half pounds and the temperature loss only 5 to 10 degrees F. This temperature loss is so small that there is no difficulty in controlling the bubble towers to give the desired end point at the outlet of the Gray tower.

The polymer fraction drains from the bottom of the tower to a drum. The float controlled pump transfers the polymers from the pump to the evaporating tower where the gasoline content is reevaporated. The polymer fraction represents about 4 per cent of the gasoline by volume and contains about 80 per cent gasoline and 20 per cent true polymer. In other words, the net loss due to polymerization is 0.8 per cent.

We use 30-60 mesh Fullers earth from Riverside, Texas. The yields of stable gasoline are dependent upon the relative

(Continued on page 93)

Waters Method for Determining Sulphur in Petroleum Products

By L. J. CATLIN
The Standard Oil Company (Kansas)

THE method herein described is not new, having been published in 1920[1], and for a number of years a description of the method was available in a publication of the Bureau of Standards[2]. However, it is thought that a re-publication of the method will not be out of place at this time, because it is the belief of the author that few refinery laboratories are at present using the method, and there must be a great many such laboratories where the equipment for the oxygen bomb method, as described in publications of the Bureau of Mines[3], is not available.

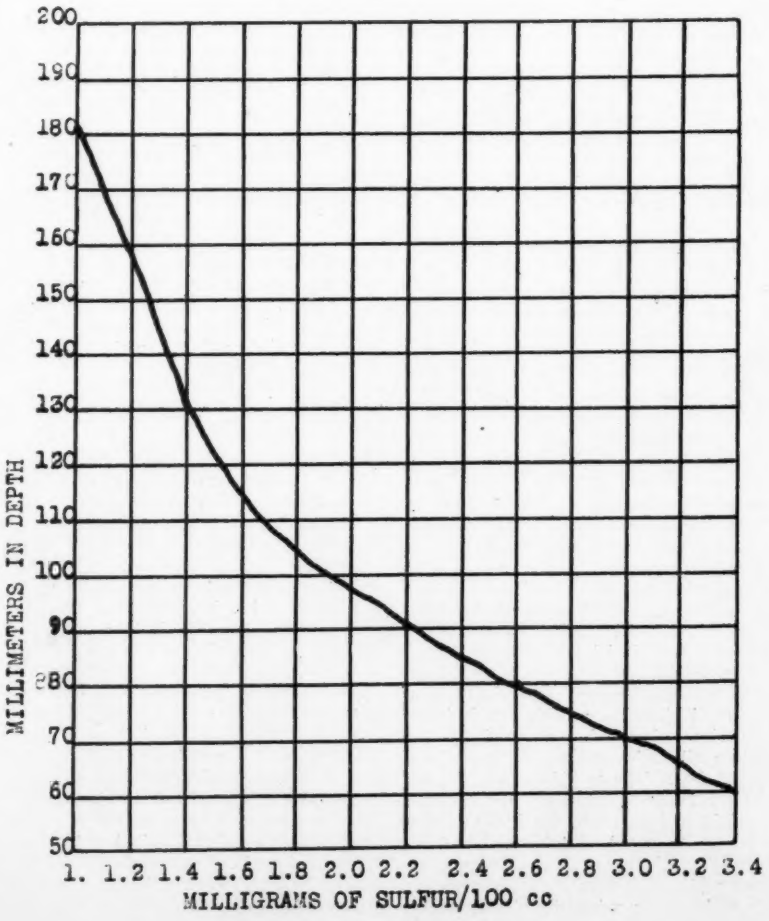
The versatility of the test is shown in the fact that it was at first developed for use in testing rubber, and later adapted to petroleum products, and the present author has found it quite satisfactory even for coke and coal. The accuracy of the method for the last named cases is not vouched for by the original author, but the average plant chemist finds that he must leave questions of extreme refinement to those who are equipped for research, and many times finds himself in a position where he must "get the answer" by the best method available, in spite of the fact that it may be open to criticism. This usually leaves him with about three rough and ready criteria by which to judge the accuracy of his work, as follows: Firstly, do the results check reasonably well with other methods available; secondly, do the results seem reasonable compared with results obtained on other products of a similiar nature; and thirdly, do the results check reasonably well with the results obtained by other chemists on the same article, as for example those representing the purchaser or seller as the case may be. Judging by these criteria, we may say that the Waters method has stood the test in at least one laboratory for about six or seven years.

The publication referred to above[2], has been out of print for some time, but a description of the method may still be obtained in the form of a Letter Circular, LC232, Department of Commerce, Bureau of Standards, June 14, 1927. Since a detailed description may be obtained by those interested, we shall give here only a sketchy review of the method, together with some notes on the application of the sulphur photometer to the method, which are not covered in the original paper.

As is usual in methods for determining sulphur, the fundamental reaction is conversion of the sulphur to sulphuric acid, and in this case precipitation as barium sulphate, which may be either weighed, or estimated from a curve prepared for a turbidimeter such as the Parr Sulphur Photometer. The oxidation of sulphur to sulphuric acid is accomplished by treating the oil with concentrated nitric acid which is saturated with bromine, and digesting on a steam bath from two to three hours in a covered crucible. If an ordinary crucible cover is put on up-side-down it acts as a reflux condenser for the acid, and the slope is such that the drops fall back inside the crucible instead of being conducted to the sides where much of it may run outside to cause trouble in the steam bath. Following this digestion, the remaining acid is neutralized with anhydrous sodium carbonate, using a little in excess. The amount of excess depends a great deal upon the character of the sample being tested. Ordinarily, the more volatile the sample the more excess sodium carbonate required. In the original paper it was recommended that enough be added to make a sort of thick paste which can be spread on the sides of the crucible. In practice it is somewhat of an art to be learned by experience, to rightly proportion the amount of excess sodium carbonate to the quantity and quality of oil being tested in order to get the proper sort of ignition following this step.

Drying

As indicated, the next step in the process is drying and ignition of the mix just made. Drying may be done in an over, or if great caution is taken to avoid loss it may be done over a low flame from the laboratory burner. After driving off the the moisture the heating is continued at a point near the edge of the pasty material, which in any case should be well spread up the sides of the crucible as soon as it is of proper consistency, and the ignition should be carried out as quietly as possible, using a stirring rod to control the rate, till all organic matter is burned and a clear white residue left in the crucible. In the case of coke or coal, containing ash, the residue may be discolored, but all



carbonaceous matter must be burned. It is also important that the gas used in the burner be free from sulphur, or of sufficiently uniform quality that a blank determination may be made to show the effects of sulphur in the gas. If the material seems too dry and slow in ignition it may be speeded up by cautiously adding potassium nitrate crystals, or concentrated nitric acid.

After cooling, the crucible, the contents are dissolved in as little distilled water as possible, and the excess sodium carbonate neutralized with hydrochloric acid, adding about 3 to 5 cc. in excess. Solution may be hastened by adding part of the hydrochloric acid while dissolving. The crucible and contents may be placed in a beaker of proper size and when solution is completed the crucible rinsed and removed. Heat sufficiently to expell all carbon dioxide, then cool and the solution is ready for precipitation of the sulphuric acid in the sample.

The precipitant used at this point depends upon the method to be used in determining the amount of precipitate formed. If it is to be weighed, add 10 per cent solution of barium chloride to form barium sulphate, allow to set over night, and filter. The precipitate is thoroughly washed, ignited on an ashless filter paper and weighed. The original paper calls for a deduction of 5 per cent from the weight thus found, to allow for occlusion of other salts in the barium sulphate preciptate. After this deduction the weight of sulphur may be calculated from the weight of barium sulphate found, by multiplying by 0.1373. A table is given accompanying the original paper for making both the correction and calculation directly from the weight of precipitate. This weight of sulphur is of course referred to the weight of sample used to determine the percentage of sulphur.

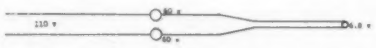
Measurement

If the amount of barium sulphate is to be determined by measurement of turbidity, as with the Parr Sulphur Photometer, a special precipitant is used which causes the precipitate to remain in suspension for a longer period while readings are being taken. The precipitant first used in this instrument was called barium oxalate, and was composed of equal parts of barium chloride and oxalic acid, finely pulverized and well mixed. More recently the manufacturers have obtained similar results by the use of a special barium chloride containing no oxalic acid, but graded as to size of crystals. The precipitant is added in the dry, or crystal form, and any occlusion of other salts is taken care of in the calibration of the instrument, described later.

The sulphur photometer is merely a turbidimeter, composed essentially of a graduated glass tube which sets inside a tube of metal or other material for excluding all light except that admitted from below. The turbid solution is run into the tube while the operator watches the light and notes the depth of solution necessary to completely obscure the light. Regardless of any curves or tables which come with the instrument it is necessary for each person using the photometer to check himself and the instrument by using solutions of known sulphur content and either training his eye to check the values given on the curve or table, or making a new one to suit the conditions, and then adhering strictly to the conditions used in making the calibration when testing unknowns. This checking should be repeated frequently and especially in the case of renewal of tubes or light bulbs, etc., after breakage.

Standard solutions for this purpose may be made up of potassium sulphate of C. P. quality, using such strength that after adding the precipitant the turbidity brings the solution within the range of the graduated tube and light used. For use with the method here described, the standardization of the instrument should be done with solutions containing approximately the same amounts of other salts as that found in the solutions to be tested. In other words, a "blank" may be made up in which everything is added as is a regular test, except that instead of adding oil, a known amount of potassium sulphate is added. This is conveniently done by making up a standard solution containing 0.5444 grams of potassium sulphate per liter. One cubic centimeter of this solution contains .0001 gram of sulphur. By adding different amounts of this solution and using distilled water to bring the total volume of solution to 100 cc. each time, a curve may be plotted using readings on the graduated tube as one of the co-ordinates, and grams of sulphur as the other. The curve in the accompanying illustration, Figure 1, is the one given for use with the Parr Sulphur Photometer.

It is readily seen that the use of the photometer requires a light of constant intensity. For this purpose the ordinary dry cell battery is not very satisfactory as a source of current on account of polarization, gradual deterioration, etc. The regular lighting circuit may be used by fixing up a lamp-bank rheostat which will reduce the voltage to that suitable for the bulb used on the photometer. The Author uses a 6.8 V. Ford tail light bulb, having in the circuit two 60 watt Mazda lights in series as shown in the following diagram:



This arrangement, together with a curve plotted to suit conditions, gives results quite reliable and consistent.

In making regular tests it will, of course, not always be possible to so choose the amount of sample that photometer readings will be within the range of the curve by simply making the solution up to 100 cc. It is best always to keep on the safe side by using more than is necessary for the 100 cc. quantity, and then diluting to the proper volume. For example, referring to the curve, Figure 1, if we have a sample containing 3.4 mg. of sulphur, and bring the volume of the solution to 100 cc. we should get a reading of 60 on the graduated tube. If we make this same solution up to a volume of 200 cc. it is evident that it still has in it the 3.4 mg. of sulphur, and each 100 cc. now contains 1.7 mg., which give us a reading of about 108. In other words, the solution as obtained from the sample run, may be made up to any convenient multiple of 100 cc. till it brings it within the range of the photometer and curve, and then multiply the result obtained for 100 cc. by the factor necessary to account for the total volume used.

Advantages and Limitations

Some of the advantages, as well as the limitations, of the Waters method for sulphur determination in petroleum products may be summed up as follows: Chief among advantages is the fact that only ordinary laboratory apparatus, such as balances, crucibles, burners, and steam bath, are required. Also, the amount of sample burned may be varied within wide limits, according to the amount of sulphur to be found, thus bringing the amount of sulphuric acid formed within a range suited to the method employed in measuring it. This is best appreciated when we note that the bomb methods do not allow the use of more than .6 to .8 grams of sample, and in some cases only .2 to .3 grams. If the oil being tested is low in sulphur content the amount of precipitate formed is so small as to make accuracy of measurement very difficult. Also in most cases it will be so small as to be outside the range of such time saving methods as the photometer. The preparation and ignition of the sample requires more time than by the bomb method, but this may be more than offset by the fact that several samples may be prepared simultaneously. The accuracy of the method has been carefully checked by the Bureau of Standards, and other investigators, and may be considered at least equal to that of the bomb method. It has been shown that even with the bumb using oxygen pressures up to 50 atmospheres (*4) sulphur dioxide may be formed from as much as 43 per cent of the sulphur burned by the ordinary methods and this may be mostly lost when the bomb is opened. The Waters method is suited to all oils that are too heavy for burning in lamps, even to asphalts, and will give results on burning coke which are perhaps as accurate as any other method at present in common use. It is not suited to volatile oils, but these are more conveniently tested by the lamp method.

1. Waters, Journal Ind. & Eng. Chem., Vol. 12, No. 5, May, 1920.
2. Waters, Bur. Stds. Tech., Paper 177.
3. Bureau of Mines Tech., Paper 323A, 1924. Method 520.21.
4. Bradley, Corbin & Floyd, Ind. & Eng. Chem., Vol. 18, No. 6, June, 1926.

Colorado, Texas.—Increased crude supply from Mitchell and Howard Counties, West Texas, has resulted in the Col-Tex Refining Company adding new stills, fractionating towers, etc., to increase the capacity of its skimming plant here from 6000 to 8500 barrels daily. Col-Tex Refining Company is owned jointly by the Anderson-Prichard Oil Corporation, Oklahoma City, and The California Company, subsidiary of Standard of California, and is making a specialty of an anti-knock gasoline.

Cleanest Plant Is Claim For Titusville Refinery

UP in Titusville, D. W. McGraw, Sr., will tell you that the plant of the Oil Creek Refining Company is "the cleanest in the United States." Since 1882, when he first came in contact with refining, he has much to do with refinery operation. He has built several plants and his one hobby is good housekeeping. He insists that "cleanliness is the first rule of safety and the most effective."

Mr. McGraw is president of the company. It was built seven years ago and has been operated under his supervision.

After 45 years in the refining industry Mr. McGraw confesses to having earned a reputation of being very exacting in the matter of operating a well kept and orderly plant. But the Oil Creek plant, now seven years old, has established some enviable records. It has experienced the very minimum of fires, none in fact of a serious nature. It has reduced its accident rate to about the lowest known. The labor turn-over for the entire company is less than one-fourth of a man per year. These three items are usually of major importance in refineries where many grades of lubricating oils are made,—where wax is manufactured, in addition to the conventional skimming plant operation. Accidents and fires are invariably of more expense than appears on the surface, and labor-turnover is quite as serious from a monetary viewpoint, although not quite so tangible.

VIEW FROM THE REAR OF THE OIL CREEK REFINING COMPANY PLANT SHOWING SOMETHING OF THE GENERAL CLEANLINESS OF THE PLANT. TANKS, AGITATOR, AND OTHER EQUIPMENT ARE NOTICEABLY FREE OF DARK OIL SPOTS.

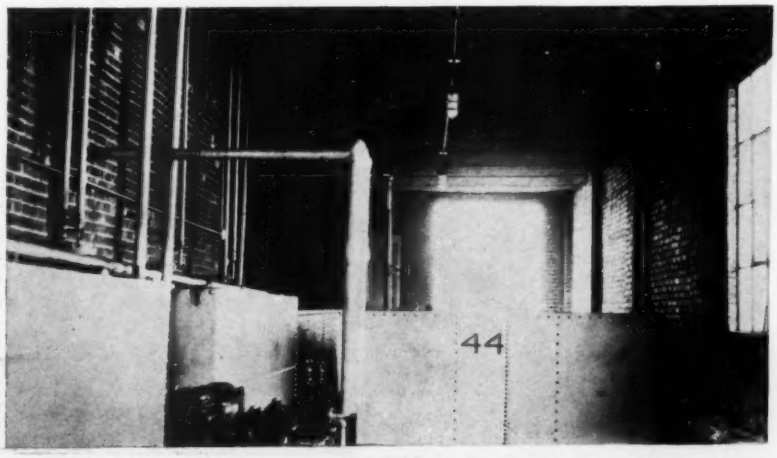
Much Painting

Paint is generously applied to all metal parts of the plant, such as tanks, vats, lines, machinery and walls of buildings where wood is used. Wood, however, occurs but little, since practically all of the buildings are of brick and concrete construction, re-inforced with railroad iron.

After the paint is put on, it is kept clean. Tanks are not to be run over, naturally, but when this does occur the man who runs it over must clean it. Additional paint is kept at hand for use when needed. In the photo showing the interior of the heavy lubricating oil filter house it will be noticed that the small tanks are bright with aluminum paint. This paint was applied last year and it is still clean. Dirty overalls would soil these tanks.

Therefore, the men do not wear dirty overalls. The floors of all of the buildings, filter houses, pump houses, earth furnace room, ammonia or refrigerating plant, even the sweating rooms and the wax-press rooms, of which there are four, are clean. Concrete floors are not oil spotted. If oil is spilled—a little naphtha washes the spot.

Wax press rooms and sweating rooms of many refineries often offer the most difficult problem in the matter of good housekeeping, and often the floors around the wax press are so deep in slippery wax that they are dangerous and hazardous to the operators. With a little care in dumping the press to the end that all of the wax finds its way to the conveyor and out of the room, an occasional washing with naphtha, and with clean shoes on the feet of the men, these rooms are kept clean and dry and safe.



INTERIOR OF THE HEAVY LUBRICATING OIL FILTER HOUSE SHOWING HOW THE TANKS, LINES, PUMPS, ETC., ARE ALL KEPT BRIGHTLY CLEAN. THE FLOOR, ALSO, IS AS CLEAN AS THE TANKS.

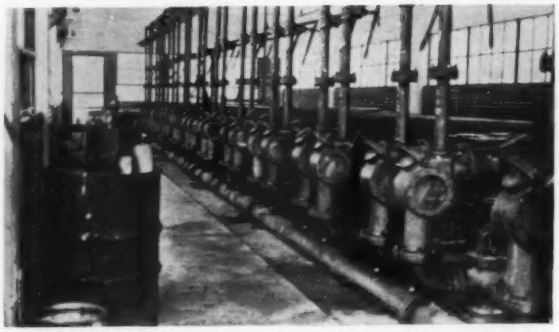
Exhaust Steam for Sweating

The Oil Creek Refining Company does not sweat its wax with steam in coils as is the usual practice, but by constructing buildings of brick and with tight doors are enabled to heat the entire room for sweating the wax in the teir of pans by means of exhaust steam. The condensed moisture falling to the floor is drained off through a central drain pipe in the floor.

Sumps and waste oil traps have been avoided to a great extent and where such slops accumulate the pit is frequently pumped free of oil and water. The plant where the company generates its own electricity for power is spotless with generators and machinery wiped dry and shining. Brooms are everywhere in evidence, but be-

(Continued on page 93.)

OFFICE BUILDING AT THE PENNZOIL COMPANY'S PLANT No. 1, ROUSEVILLE, NEAR OIL CITY



INTERIOR OF THE RECEIVING HOUSE THROUGH WHICH 24 STREAMS MAY PASS. NOTE GAS TIGHT LOOK BOXES.

Pennzoil Puts Waste Heat to Work

Recent installations at Rouseville show what can be done to prevent energy going up the stack

By GEORGE REID
Associate Editor

THE Pennzoil Company has, during the past year virtually doubled the capacity of its refinery at Rousville, Pennsylvania. Embodied in the additional refining units is equipment of the latest design and incorporating engineering features which are of much interest due to the fact that certain departures from usual skimming plant methods are in evidence.

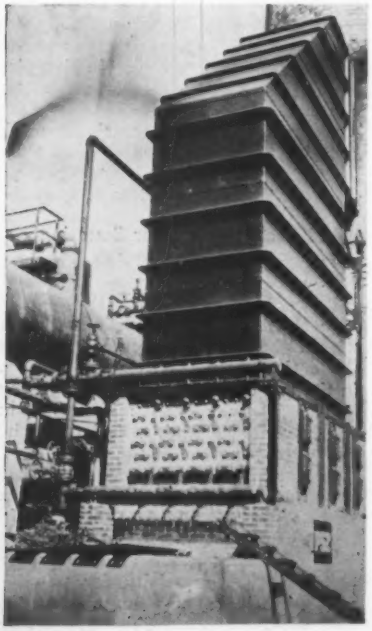
The new refinery unit consists of one Foster tube still which acts as a separate reducing unit working in conjunction with two shell still type horizontal separating chambers; a battery of seven 1000 barrel capacity horizontal shell stills for continuous operation in which the crude is further reduced after passing through a tubular retort of company design built into the flue leading from the battery of crude still, and the Foster tube still. This waste heat tube still is placed virtually at the bottom of the brick stack.

For the past few years refiners have been studying the utilization of waste heat going into their stacks, and there are several installations in this country of waste heat boilers, or steam superheaters, in successful operation which are built into the channel conducting flue gases from stills to stack. The Pennzoil Company has been operating one of these steam generative or superheating plants in the flue passage leading from its old battery of continuous stills to the stack with very gratifying results. Its present installation of a crude oil tubular retort which operates as a distillation unit and derives all of its heat from hot gases leaving the combustion chambers of other portions of the distillation system is one of the first of its kind to be perefected within the industry. The "waste heat" tubular retort is the design of company engineers with H. S. Bell, New York, acting as consultant with regard to the recently completed new refining unit.

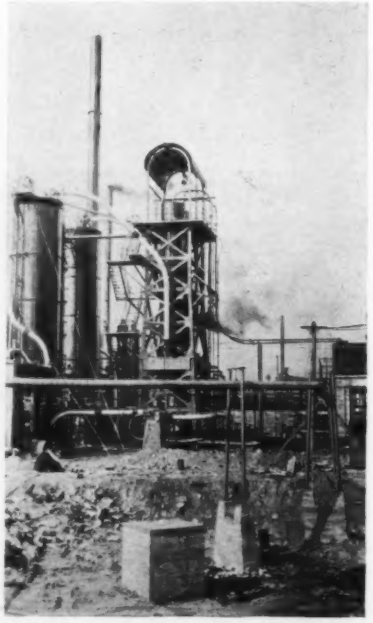
Pipe Still

The new plant is of such recent completion that exact figures as to efficiencies were not yet obtainable. The operation however was satisfactory to the extent that the attention of the industry may well be attracted to this progressive step in petroleum refining. Vast amounts of valuable heat is being wasted daily among refiners through lack of knowledge or investigation of the possibilities of utilization of the stack losses. Pennzol's new unit, distilling an appreciable portion of the lighter fractions through the insertion of tube banks in the flue passage, is a step in the right direction.

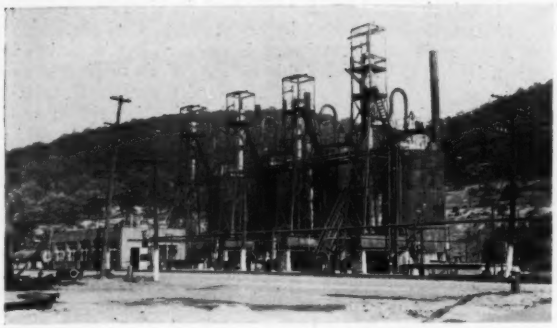
In the order of their installation the new equipment now in operation at this plant consists first of a Foster type tube still which functions as a circulation unit. Its operation is very similar to that now becoming conventional practice in the distillation of Pennsylvania crude through the pipe still apparatus. Crude oil is charged to one of two large horizontal shell still type separator chambers through Leach heat exchangers. While the tube still is heating one batch of crude by cir-



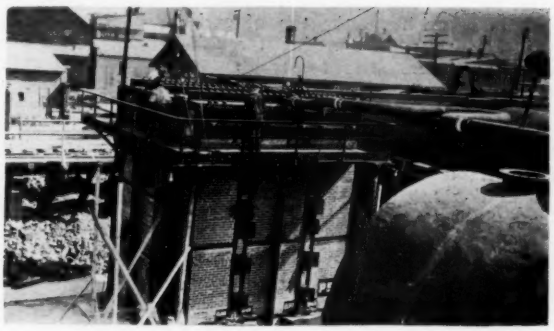
TUBE STILL BUILT INTO FOOT OF STACK. CRUDE OIL IS PASSED THROUGH THIS STILL.



TWO LATE TYPE DUBBS CRACKING UNITS UNDER CONSTRUCTION, PENNZOIL PLANT No. 2.



FLEMMING CRACKING UNITS IN OPERATION FOR THE PAST FOUR YEARS AT PLANT No. 2.



FOSTER HEATER OR PIPE STILL UNDER CONSTRUCTION AT PENNZOIL REFINERY No. 1.

culation through the tubes, the section separator chamber is being charged through the Leach condensing-exchangers. When distillation of the first batch of oil is completed, the second batch is through charging into the second chamber and the pump, National Transit hot oil, size 10 by 8 by 18 in this instance, is switched to the second chamber or separator full of oil—and this batch heated, and reduced to a predetermined flash point.

In this manner Pennsylvania crude oil is being handled with the pipe still. Attention is called to this unit for the reason that here is another company which has overridden prejudice and successfully applied modern scientific equipment in the manufacture of lubricants with the pipe still heating unit.

Vapor Heat Exchange

Vapor heat exchange is also employed in the newer refining plant on the same site and adjacent to the old battery or unit. The vapors, after fractionation in the Bell type bubble towers, which are really modified Bells, since certain features of company design are incorporated in their construction, are conducted through Ross vapor-heat exchangers. The equipment being described is shown in the accompanying photographs. Crude oil charging to the battery, first flows through five vapor-heat exchangers which act as preheaters. The flow proceeds through them in series, to leave the last of the exchangers sufficiently heated to cause the vaporization of a large proportion of the light gasoline. This vaporization is effected by passing through a flash chamber or separator. The preheated crude oil enters the waste heat economizing tube still, flowing through 72 joints of two-inch tubes 13 feet long. The temperature of the flue gases as they flow toward the stack is from 750 to 800 degrees F. As all of these hot gases must pass through the zone in which the tube banks are inserted, and are equally distributed around the tubes, an exchange of heat is effected, raising the temperature of the oil sufficient to cause the vaporization and distillation of all of the gasoline content of the crude. This is usually around 25 per cent of the oil as run in the plant.

ROUTINE AND RESEARCH LABORATORY, PLANT No. 1.

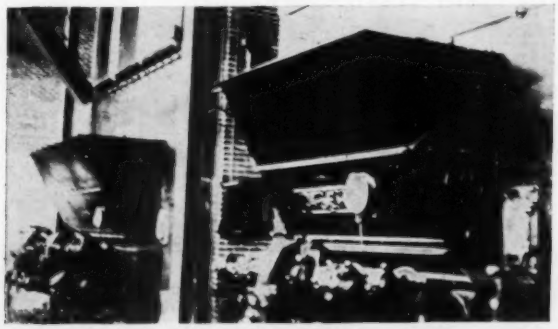
The flue gases in passing through the tube banks, are reduced in temperature to about half the former temperature, or from 350 to 400 degrees F. In this manner the utilization of heat formerly wasted or at least less effectively conserved, brings about the distillation of around 25 per cent of the crude charged to the plant—without the application of any direct fire.

The oil heated in this manner is conducted away from the "flue-tube still" and into the flash chamber or vertical vaporizor, where the separation of vapor and residuum takes place. The vapors enter the bubble tower, are fractionated, and pass through the vapor condenser-exchanger as previously mentioned, then to the Sterling cast iron condensers and to the receiving house.

Lubricants

Residuum leaving the separator flows by gravity into the battery of seven shell stills in continuous operation. The first two of these stills are equipped with bubble type towers and vapor condenser-exchangers, while the remainder of the stills are not equipped with towers since they are utilized for the reduction of the heavier portions of the crude.

Twenty-four Reid look boxes are provided in the receiving house, each gas tight and of sturdy construction.



AUTOMATIC WESTINGHOUSE STOKERS FIRING TWO OF THE BATTERY OF BOILERS AT PLANT No. 1.

NEW FRACTIONATING EQUIPMENT, BUBBLE TYPE TOWERS AND VAPOR CONDENSER AT NEWLY COMPLETED UNIT.

Gas lines lead from the top of each look box to a header line through which uncondensed vapors and gases are conducted to the vapor recovery plant. These lines are equipped with hand operated lift valves, which must be opened by pulling up the handle. The advantage of this type of valve lies in the fact that a glance is sufficient to ascertain whether or not they are opened or closed—since the handles protrude when the valve is open.

The conventional practice of gathering samples by means of the dip can is also done away with, as each look box is provided with a separate drain pipe and nickeled faucet. The receiving house is well lighted and ventilated, and being a closed system of handling liquids through the house, the operator is never in danger of gas. Steam coils are provided to keep the room warm during winter. Leeds and Northrup recorder controllers are installed for control of operations of the tube stills and bubble towers.

The lubricating department of the Pennzoil plant is also provided with equipment of the latest design. Two Nichols-Herreschoff furnaces are in operation for burning the fullers earth used in filtration work. These furnaces tend to make the useful life of the earth indefinite. The actual life of the earth when handled in these furnaces is not yet determined.

The actual reduction of lubricating oils is a procedure of precision, and great care is taken in processing through the various steps of filtration, chilling, dewaxing, redistillation and further filtration. The oils are dewaxed by both the centrifugal method and the Carbondale pressing procedure. In this last the wax distillate is first dewaxed to a large extent by what is called hot pressing, or pressing the wax out of the oil at around atmospheric temperatures. This first pressing removes much of it, and the subsequent chilling and pressing at very low temperatures assures the removal of the remainder. From the pressed wax is produced white crystalline wax in the usual manner. The lubricating oils are then processed by reduction and filtration and finished as motor oil lubricants.

Light Products

Pennzoil's plant No. 2, which is near the installation just described is operated mostly for the production of gasoline, naphthas and kerosene, which is derived from the benzine produced in the No. 1 plant and from the company's cracking units. Four Fleming units are in operation which have been yielding gasoline from the light fuel oil as prepared from Pennsylvania crude, a gas oil cut, taken over head, for the past four years. The units operate at 70 pounds pressure and around 800 degrees F. Operation is very smooth, but like all high pressure installations eternal vigilance is necessary as the price of safety. Gasoline from the Flemming stills is sweet and of good color and stable to a marked degree when exposed to sunlight. Also a certain anti-knock value is claimed for it. This battery of Flemming stills is one of the few of the early installations of its kind which is still in operation.

The cracking department has recently been enlarged by the installation of two 1000-barrel Dubbs units. These units are equipped with the new type of 10 by 40 feet expansion chambers.

The Pennzoil Company maintains a large well equipped laboratory which is the control point of the plant operations. The building is two story, with the lower floor given over to routine testing and analysis, and in this department all products are checked during manufacture process, and inspected prior to shipment. The upper oflor of the laboratory building has been set aside for a research laboratory. The main room is large and commodious, provided with well arranged cabinets, tables, and filing racks. It is well lighted and ventilated.

Changes in Natural Gasoline Specifications Become Effective October 1

TWO changes in specifications of natural gasoline by the code of the Association of Natural Gasoline Manufacturers will take effect October 1. One is the introduction of the corrosion test into the specifications. This test will be made in accordance with requirements of the Bureau of Mines, as published in Bulletin 323 A.

The other change will make the upper limit of Grade C natural gasoline 92 A. P. I. gravity. Previously the upper limit on this grade has been 90 degrees A. P. I., with the lower limit 80 degrees.

These changes were suggested at the spring meeting of the association in Tulsa. Following approval of the board of directors a mail vote was taken among members and adoption followed.

Specifications on natural gasoline are now as follows:

Grade AA—Recovery not less than 90 per cent; end point not over 375 degrees F.; gravity 80 to 87.9 A. P. I.

Grade A—Recovery not less than 90 per cent; end point, not less than 375 degrees F.; gravity 72. to 79.9 A. P. I.

Grade BB—Recovery not less than 85 per cent; end point, not over 375 degrees F.; gravity 84 to 92 A. P. I.

Grade B—Recovery, not less than 85 per cent; end point, not over 375 degrees F.; gravity 76 to 83.9 A. P. I.

Grade C—Recovery, not less than 78 per cent; end point, not over 375 degrees F.; gravity 80 to 92 A. P. I.

Color—The color of all grades must be plus 25 Saybolt chronometer.

Corrosion test—Method 530.21 from Bulletin 323A of the United States Bureau of Mines.

The corrosion requirement has become necessary because about one-fifth of the natural gasoline produced does not meet the test. The standard A. S. T. M. method, known as D- 130-22 T, was adopted. This is the copper strip test and is similar to No. 530.21 corrosion test at 122 degrees Fahrenheit as outlined in Technical Paper 323A of the Bureau of Mines under date March, 1924. The corrosion test is required by most domestic buyers and by all export marketers.

The committee on specifications of the Association of Natural Gasoline Manufacturers is composed of John N. Hall, Oil State Gasoline Company, chairman; A. F. Wood, Chestnut and Smith Corporation; Dr. E. R. Lederer, Texas Pacific Coal & Oil Company; G. P. Bunn, Phillips Petroleum Company; J. R. Jarvis, Lone Star Gas Company, and S. B. Crooks, Empire Gasoline Company.

Second Technical Meeting In Kansas

Wichita, Kan.— The second technical meeting of the Western Petroleum Refiners Association closed here October 11, after a session the previous day in El Dorado. These technical meetings are the result of the policy of the association in confining its annual convention anl leaving technical subjects off the program.

With the one day annual convention, it was decided to hold several technical meetings each year, distributing these in the several refining centers. The first was held in Wichita Falls last spring.

In El Dorado the morning was devoted to a technical meeting, with a visit to refining plants in the afternoon. Similar division was made of the day in Wichita.

C. E. Henderson, vice president of the manufacturers committee of the association, presided over the two meetings.

At El Dorado, F. C. Koch, of Winkler & Koch, presented a paper on distillation and fractionation. It was followed by discussion. Don J. Wallace, safety director of the Mid-Continent Oil & Gas Association, discussed "Practical Refinery Safety."

In the afternoon, inspection trips were made through the plant of the Skelly Oil Company in El Dorado and the plant of White Eagle Oil & Refining Company at Wichita.

The meeting in Wichita at the Lassen Hotel, had the following program:

"Automatic Process Control," F. M. Poole, Brown Instrument Company.

"Fuel Economy in Refineries," P. W. Thomas, Combustion Equipment Company.

"Treating of Light Oil Products," A. Henriksen, chief chemist Marland Refining Company.

Refineries visited in the afternoon included Derby Oil & Refining Company, Barnsdall Refining Company and Golden Rule Refining Company, all of Wichita, and the Vickers Petroleum Company at Potwin.

Beyond the Range of All Other Methods

67 feet in length—10 feet inside diameter —wall thickness 3½ inches

On July 14th, 1927, the record breaking cracking still shown above was completed and shipped.

The achievement in building a cracking still of such capacity, important as it is to the oil refining industry, is overshadowed by the co-ordination of engineering, laboratory and production facilities that make possible the building of Smithsteel Cracking Stills, large or small, standard or special, to meet usual or unusual refinery requirements.

The Largest Still Ever Built

This still is the largest cracking still ever built, almost 70 feet long, 10 feet inside diameter, and wall thickness of 3½ inches, weight 366,600 lbs. The largest still built previously was also of Smithsteel, with a length of 65 feet, diameter of 8 feet and wall thickness of 3½ inches, weight 268,000 lbs.

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Results of Acid Treatment of Fullers Earth

By H. L. KAUFFMAN
Petroleum Chemist

THE interest on the part of refiners in the use of decolorizing clays of high absorbitive value for the purification of petroleum products has shown marked increase during the past five years, as indicated by the gradually increasing number of contact filtration plants that are being installed.

In many of these plants these high adsorbtive, acid-treated clays are used as the decolorizing and de-acidifying medium for the purification of the oil.

The raw clays used most frequently for the preparation of these finished, high adsorbent mediums are usually clays of the bentonite type. Many of such clays, when ground to 200-mesh fineness and treated with from 40 to 50 per cent by weight of sulphuric acid and thereafter washed free of excess acid and the products of the reaction, become from 4 to 10 times as efficient as finely ground fullers earth for decolorizing mineral oils; whereas, before acid treatment, the same clay will be only about one-half (sometimes more, sometimes less) as efficient as fullers earth of the same mesh in fineness. The increase in efficiency of such acid-treated bentonites is largely due to a change in the internal structure of the pores of the clay, although a chemical reaction also takes place as indicated by the fact that a large portion of acid-soluble compounds (aluminum and alkaline salts, etc.) are removed from the clay by the action of the acid.

On numerous occasions the writer has been asked as to the results of the action of a similar acid treatment on fullers earth; that is, does acid treatment increase the decolorizing efficiency of fullers earth and, if so, are the results obtained such that an acid treatment of fullers earth would be economically feasible. The present article will summarize the results of a number of tests made for the purpose of answering those particular questions.

What Fullers Earth Is

However, before entering upon this discussion, mention might well be made at this time of the nature of fullers earth, how it is mined, ground, etc., all of which it is believed the reader will find of interest.

For the information given in succeeding paragraphs relative to the mining and other steps involved in the preparation of fullers earth for market, the writer is indebted to Mr. John Maris, vice-president of the Attapugus Clay Company, Philadelphia, Pa., who furnished the following information in a personal communication:

"Fullers earth was first used for 'fulling,' or removing grease from woolen goods. This is the use that gave it its name, but it has now been largely superseded for this purpose by soap. It has the property of adsorbing basic colors, and is now largely used for decolorizing oils. It is commonly called "clay" by the petroleum refiners and is a mineral containing aluminum silicate like other clays found in many localities in the United States and elsewhere in the world. Various fullers earths, usually, but not always, of sedimentary origin, come from different geological periods and have different chemical makeups. But these factors do not seem to control its bleaching values, which may depend more on its physical structure, and it is the bleaching value, together with the weight, fracture, hardness, availability, etc., that classify certain fullers earth deposits as more desirable than others.

"Georgia is the leading state in output and value of fullers earth, with Florida second and Texas, third.

"The occurrence and method of mining fullers earth in the South, as sometimes practiced, is as follows: The earth is found in more or less horizontal veins. The veins often vary in thickness from one to 20 feet. They are overlaid by deposits varying in depth of from one foot to as much as 45 to 50 feet. This overburden often consists of loam, sand, red and yellow clay, pipe clay and sand rock, all of which must be removed before the fullers earth can be mined. The fullers earth vein can easily be distinguished from the other materials over and underlying it.

Mining

"The first operation in mining is the removal or stripping of the overburden. This is accomplished with large steam shovels. If the overburden is deep, sometimes it must be removed in two benches. Sometimes the removal of the over burden is kept well in advance of the removal of the fullers earth, so that at all times there are many months' supply of actual fullers earth uncovered. To protect the earth from the weather, when so mined, a foot or so of overburden is left in the stripping operation and when the earth is ready to be mined this protecting layer is removed with a second set of steam shovels, and the exposed earth is mined with a third set of shovels, usually of the caterpillar tread type.

"The earth is placed in cars and hauled to the plant proper and dumped into the "wet clay shed", where it undergoes a certain amount of air-drying. The earth is delivered to this wet clayshed in lumps, as it comes from the mine varying in size from an inch to 15 inches or more. It is then crushed in roll crushers to about the size of a walnut or smaller, and dried by passing through oil-fired rotary kilns, very similar in construction and design to those used in a cement plant. The total volatile content, including moisture, is thereby reduced from about 50 per cent to 20 per cent, or less. The earth is then conveyed to ventilated cooling tanks and then to the top of the mill proper.

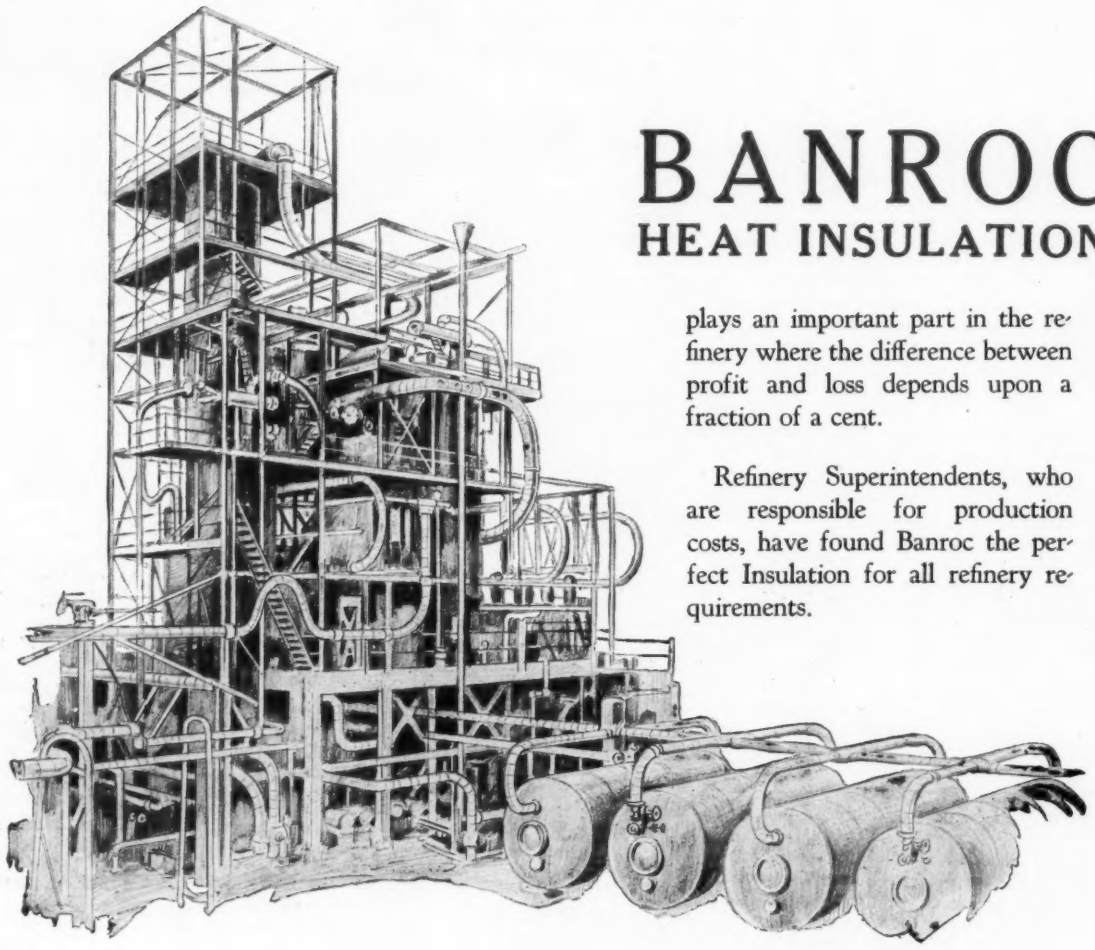
Milling

"The clay is then crushed in high speed roll mills and screened. The roll surfaces are usually corrugated to reduce pulverization. The mills are usually arranged in rows, and the material which the first mill fails to crush fine enough for even the most coarse commercial grade, is returned to the second mill and so on. The screening is done either in reel bolters or shakers, and the earth is thus separated into various meshings. The screens themselves are usually made of silk, although wire screen may be used, particularly on the very coarest grades. The meshes commonly made are 15/30, 30/60, 60/90 and 100/up. Other meshings are sometimes required. By "15/30 mesh" is meant earth that will fall through a screen of the specified kind, having 15 meshes to the linear inch and be retained on a certain screen having 30 meshes to the linear inch. The earth after being screened goes through chutes to bins. It is then weighed out of the bins by automatic weighers and is packed in burlap bags for shipment.

"The mill operation itself is somewhat similar to that practiced in flour mills. From the time the earth is dumped in the wet clay shed, until it is packed in bags, there is no manual handling.

"To insure uniformity of meshing, etc., samples of the earth are tested at very frequent definite intervals, day and night."

The fullers earth used in making the tests was a sample of Georgia fullers earth of the grade known as "100-up" mesh. This clay was treated with 50



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per cent by weight of sulphuric acid and applied to the oil in the form of a clay-pulp, which was first washed free of all excess acid and acid-reaction products.

In preparing this acid-treated pulp, 66° Be. sulphuric acid was added to the finely ground clay in an amount equal to 50 per cent by weight of the clay. Enough water was then added to give an acid concentration of 20 per cent, the whole thereafter being digested under a reflux condenser for five hours at 200 degrees F. The pulp was then washed with four successive portions of 180 degrees F. temperature wash water, using an amount of water on each wash equivalent to one gallon of water per pound of clay. After the addition of each portion of wash water, the whole was thoroughly agitated and then allowed to settle until the supernatant liquid was practically clear, after which the clear liquid was siphoned off, a fresh portion of wash water added and the operation repeated. After the last washing, all the supernatant liquid was siphoned off and a moisture determination made on the clay-pulp remaining. Knowing the water content of the wet clay, this pulp was then applied on the oil to be purified in amounts calculated on the basis of net dry clay contained therein.

Varies With Oils

The efficiency of a clay means, of course, its relative decolorizing power. As this relative value of two or more clays will vary with different oils, it must be determined for each individual case. This can best be done in the laboratory by contacting the same oil to the same color, using any number of different clays. Assign a unit value to any one of the clays and the efficiency ratios of the others is readily determined.

For instance, if it takes 20 grams of finely ground fullers earth per 100 cc of oil to give a desired color, and four gram of any other clay to obtain the same color, then the efficiency of the latter is five.

The relative efficiencies of the treated and untreated fullers earths under discussion in this article were determined in the laboratory as follows:

A certain amount of dry, untreated fullers earth was contacted with the oil to be decolorized (following the method later to be described) and the color of the filtered oil noted. Various amounts of the treated clay-pulp were then applied to the same oil stock, continuing the experimental treats until the color of the finished oil matched the color obtained by the use of a specified amount of fullers earth. Relative numerical efficiencies were then calcualted.

Experiments

In making the tests, a convenient amount of clay-pulp was added to 200 cc. of cold oil in a 1500 cc. beaker, after which the oil was heated as rapidly as possible while, at the same time, keeping the clay and oil thoroughly mixed by means of a mechanical agitator.

The oil and clay were heated in the beaker to a temperature of about 260 degrees F., which temperature was maintained until most of the foam (moisture) had been driven off. A piece of light wire fastened to the stirring paddle about 2½ inches below the top of the beaker helped to keep down the foam and speeded up the operation. From five to ten minutes time was required for most of the foam to disappear.

The oil and clay were then transferred from the beaker to a 1½ litre, round-bottom, short-necked flask. This flask was fitted with a steam line, with a thermometer extending to the bottom and with a vapor outlet. The flask was shaken gently to keep the clay from settling, while at the same time the whole was heated as rapidly as possible to the maximum temperature indicated in Table 1. A small amount of steam was turned into the flask at about 280 degrees F., this amount being increased and introduction continued until the maximum temperature desired had been reached; thereafter, the oil was steamed down to a temperature of about 300 degrees F. when the steam was "cut out." Cooling was continued without steam to a temperature of 250 degrees F., at which temperature the oil was filtered through an air-pressure filter for the removal of the clay. The color of the filtered oil was then determined and recorded.

Results

In "testing out" the dry, "100-up" mesh fullers earth, same was introduced directly to the oil in the flask, without any prior heating in an open beaker, and heated therein in the manner described for the application of the clay-pulp to the oil.

The oil used in these tests, and upon which the clays were tried, were as follows:

1. Cylinder stock residuum, acid stage, un-dewaxed, 525 flash test, "mixed base" origin.

2. Asphalt base lubricating distillate, acid stage, viscosity, 300 at 100 degrees F.

3. Medium motor oil (a finished neutral oil), color, 6 N. P. A., "mixed base" origin.

Table 1 shows the results of the filtration tests between dry, untreated fullers earth of 100-mesh fineness and the same clay, after treatment with 50 per cent by weight of acid and applied to the oil in the form of a clay pulp.

Table 2 is a condensed table showing the relative efficiencies of the treated and untreated fullers earth.

It will be noted from a study of these tables that on the cylinder stock residuum, acid stage, un-dewaxed, 525 flash test, "mixed base" origin and on the asphalt lubricating distillate, acid stage, 300 at 100° F. viscosity—on these two oils, both in acid stage, the acid-treated fullers earth was 40 per cent more efficient than the untreated earth; whereas, on the medium motor oil, neutral, color, 6 N. P. A., "mixed base" origin, the treated clay was only about 20 per cent more efficient than the untreated fullers earth.

Consequently, because the increase in efficiency is not sufficient, the treatment of fullers earth with sulphuric acid in the quantities mentioned would not be economically feasible in refinery practice.

TABLE 1
Comparative Filtration Tests Between Treated and Untreated Fullers Earth

Clay Used—	Oils Used	Amt. of clay used lbs. gal. (dry clay)	gms. 200 cc (as is)	Color N.P.A.	Efficiency	Max. Temp.
Fullers Earth, dry	No. 1, C. S. Resid.	2.0	48	7—	1.0	600°F.
Fullers Earth, 50% A. T.	No. 1, C. S. Resid.	1.4	184.5	7—	1.4	600°F.
Fullers Earth, dry	No. 2 Asphalt lube dist.	1.0	24	4	1.0	400°F.
Fullers Earth, 50% A. T.	No. 2 Asphalt lube dist.	0.3	39.5	4.5	—	400°F.
Fullers Earth, 50% A. T.	No. 2 Asphalt lube dist.	0.4	52.7	4.3—	—	400°F.
Fullers Earth, 50% A. T.	No. 2 Asphalt lube dist.	0.5	65.9	4.3	—	400°F.
Fullers Earth, 50% A. T.	No. 2 Asphalt lube dist.	0.7	92.3	4.0	1.4	400°F.
Fullers Earth, dry	No. 3, Med. Motor Oil	2.0	48	4.5	1.0	450°F.
Fullers Earth, 50% A. T.	No. 3, Med. Motor Oil	1.5	197.7	4.6	—	450°F.
Fullers Earth, 50% A. T	No. 3, Med. Motor Oil	1.7	224.	4.5+	1.2—	450°F.

TABLE 2
Condensed Table of Efficiencies

	Oil No. 1	Oil No. 2	Oil No. 3
Fullers Earth, dry	1	1	1
Fullers Earth, 50% A. T. Pulp	1.4	1.2—	1.4

Casper, Wyo.—New York Oil Company, which recently purchased the natural gasoline plant in Salt Creek from E. E. Camp, is adding more storage, painting the tanks, and will probably increase the throughput capacity. Charging capacity of the plant is 6000 gallons per day.

W. G. Cook, assistant sales manager of the New Jersey Asbestos Company of New York, has just completed an extended trip over Oklahoma. He spent considerable time around Seminole.

Characteristics of Vapors Evolved During Evaporation of Gasoline

*By J. J. DELANEY**
Gas Department, General Petroleum Corp. of California

THE characteristics of vapors evolved during the evaporation of natural gasoline have been a matter of considerable discussion in design of recovery systems and various other operations that are daily confronting the natural gasoline industry.

With this object in mind, a test was conducted to determine such characteristics using actual data secured from tests made in large enough proportions, that the experimental errors would be reduced to a minimum. The data secured to date is, however, limited to one definite condition, the partial evaporation of a tank of natural gasoline in actual service.

For the purpose of making test observations, a horizontal storage tank was used, having a 10,000 gallon total capacity, however, this tank contained only 8,320 gallons of unstabilized natural gasoline, having a gravity of 87.9 degrees A. P. I. and held under 27.5 pounds pressure.

Arrangement of Tank

During the test, the pressure was gradually reduced from 27.5 pounds to 12 pounds, which was the pressure registered at the finish of the test. This gasoline had been previously extracted from wet gas produced from the Santa Fe Springs field by the oil absorption method. All pipe connections were disconnected from the tank and equipped with blind flanges, to limit the possibility of vapors or gasoline leaking into the tank while the test was in progress, with the exception, however, of the connection used for venting the escaping vapors. This line passed from the top of the tank to a 3-inch Emco positive type gas meter which was installed for the purpose of measuring the expelled or evaporated gasoline vapors at atmospheric pressure. The meter was carefully calibrated prior to the test and adjusted to an accuracy within one per cent. A control regulator was installed before the meter and adjusted so that the flow of vapors from the tank was approximately 600 cubic feet per hour.

Temperature recording instruments were placed in the storage tank and also in the vapor line at the meter and corrections were made on these volumes of liquid and gas for the purpose of bringing all final readings to 60 degrees F. A pressure recording gauge was also installed on the storage tank and used for the readings of tank pressures as they gradually diminished.

*Read before September 15 meeting of California Natural Gasoline Association.

Details of Test

The test was conducted over a period of 22½ hours and readings were made on the tank and meter at five specified times on the first day, concluding at 6:00 p. m. No further readings of the tank or meter were made until the following morning at 8:00 a. m., when five more hourly readings were made, the test terminating at 12:00 noon. Temperature and pressure recording instruments gave the necessary data on the run through the night and charts from these instruments were used in the correction of the indicated volumes.

During the 22½-hour period of the test, there were 350 gallons of gasoline evaporated, reducing the volume in storage to 7,970 gallons. The gas meter during this period had measured 13,508 cubic feet of vapors, which when corrected, equal 13,180 cubic feet, this volume of vapors being equivalent to an evaporation of 350 gallons of gasoline, or 37.7 cubic feet of vapor per gallon. There is, however, a slight correction necessary in the above figure, amounting to one-tenth of a cubic foot, due to the fact that at the start of the test, there were 324 cubic feet of gas in the tank at 27.5 pounds pressure and at the conclusion only 276 cubic feet of gas at 12 pounds pressure. This difference of 38 cubic feet must be subtracted from the corrected meter volume, bringing this volume to 13,142 cubic feet for the 350 gallons of natural gasoline evaporated and equivalent to 37.6 cubic feet of vapor per gallon.

Results Tabulated

Through the entire test and after 5:00 p. m. of the first day when the vapor volumes were regulated with some consistency, the cubic feet of vapor per gallon of natural gasoline evaporated fluctuated only slightly, the results averaging between 37.7 and 39.8 cubic feet per gallon. An average for the period between 5:00 p. m. and 12:00 noon the following day shows a result of 38.3 cubic feet per gallon evaporated. A data sheet covering the actual conditions of the entire test is attached.

A. S. T. M. Mod. Std. distillations on the natural gasoline were made at both the start and finish of the test, extreme care was exercised in taking samples, same being transferred from the tank to steel bombs under pressure, they were removed to the laboratory and chilled to 33 degrees F. and handled at this temperature during the distillation setup; the results were as follows:

Characteristics of Gasoline

Before Test		After Test
87.4	Gravity ° A.P.I	86
	Vapor Pressure (B and E) Corrected	
12 lb.	70° F.	11 lb.
21 lb.	100° F.	20 lb.
46	I.B.P.	48
66	5%	68
75	10%	77
91	20%	92
110	30%	112
132	40%	134
162	50%	166
199	60%	204
229	70%	232
330	End Point	336
77	% Recovery	79.5
22.3	% Loss	19.7

Through the co-operation of the Carbide and Carbon Chemicals Corporation, samples of vapor and gasoline were taken at both the start and finish of the experiment and submitted to them for fractional analysis. The samples of gasoline were collected from the tanks, both at the start and finish of the test under the prevailing tank pressure, and delivered to the Carbide Company in steel bombs. From the analysis of the vapor at the start and finish of the test, the average analysis of the gas evolved was calculated. This calculation along with the fractional analysis of the initial and final gas evolved appear as follows:

Fractional Analysis of Vapors From Storage Tank at Start of Run July 30, 1927
Tank Pressure 27.5 lb.

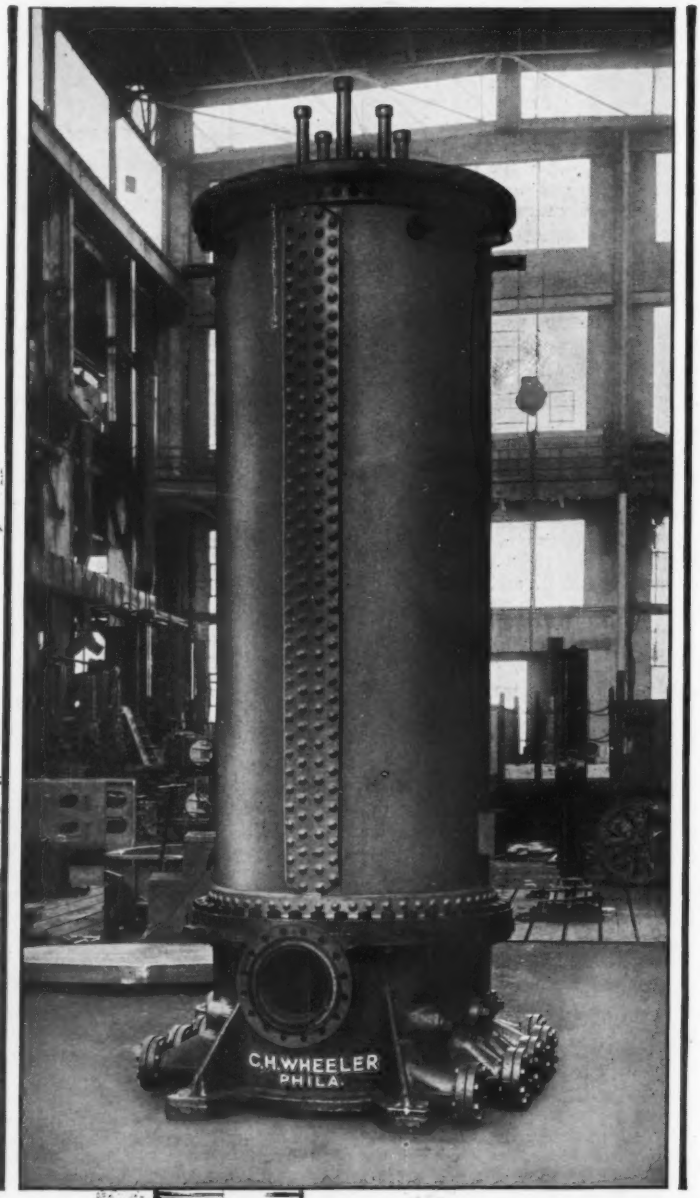
	By Volume Per Cent
Air	0.0
Methane Nitrogen	8.1
Ethane	13.9
Carbon Dioxide	1.0
Propane	29.4
Butane	41.7
Pentane, etc	5.9
Total	100.0

Fractional Analysis of Vapors from Storage Tank at Completion of Run, July 31, 1927
Tank Pressure 12 lb.

	By Volume Per Cent
Air	0.0
Methane Nitrogen	1.2
Ethane	10.5
Carbon Dioxide	0.3
Propane	34.9
Butane	46.5
Pentane, etc.	6.6
Total	100.0

(Continued on page 66)

ANNOUNCING



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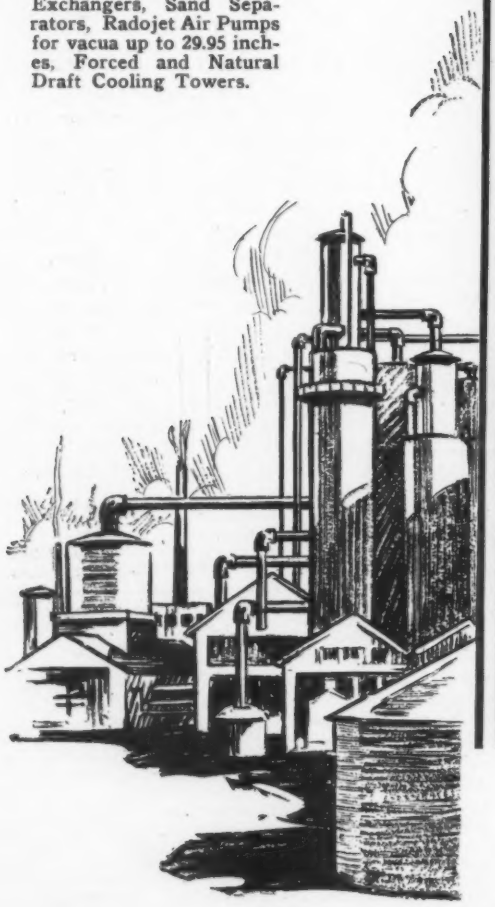

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We have completed a license agreement with Mr. C. H. Leach of Boston, Massachusetts, for the manufacture and sale (under protection of the Leach patents) of the Leach Fracto Condenser and Heat Exchanger. We are therefore in a position to offer this equipment to oil refineries and to all other process industries employing vacuum, atmospheric or pressure distillation of liquids in their manufacturing processes.

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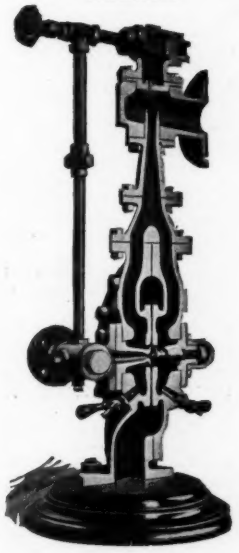

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Characteristics of Vapors Evolved During Evaporation of Gasoline

(Continued from page 63)

Average Analysis of Vapors Evaporated

	By Volume Per Cent
Air	0.00
Methane Nitrogen	4.65
Ethane	12.20
Carbon Dioxide	.65
Propane	32.15
Butane	44.10
Pentane, etc.	6.25
Total	100.00

Fractional Analysis of Natural Gasoline from Tank at Start of Run, July 30, 1927
Tank pressure 27.5 lbs.

	Per Cent by Weight	Per Cent by Volume Liquid State	Per Cent by Volume Gaseous State
Ethane	0.6	0.9	1.4%
Propane	5.8	6.9	9.5%
Butane	27.0	28.9	33.4
Pentane, etc	66.6	63.3	55.7
Total	100.0	100.0	100.0

Gravity of Gasoline 87.4
Gravity of Pentane, etc., fraction 74.2

Fractional Analysis of Natural Gasoline from Tank at Completion of Run, July 31, 1927
Tank Pressure 12 lb.

Ethane	0.3	0.4	0.7
Propane	4.9	5.9	8.2
Butane	24.7	26.6	31.2
Pentane, etc.	70.1	67.1	59.9
Total	100.0	100.0	100.0

Gravity of Gasoline 86.0
Gravity of Pentane, etc., fraction 73.5

Note per cent by volume in gaseous state are calculated on the assumption that the pentane and heavier constituents have the average characteristics of hexane and a molecular weight of 86. This is a reasonable and safe assumption.

Taking the average calculated analysis and using the normal cubic feet per gallon of each component, a calculated figure of 38.115 cubic feet per gallon is obtained as check upon the experimental result of 37.6 cubic feet. This figure was arrived at in the following manner:

Average Composition of Vapors from Tank Per Cent Volume		*Volume of Vapor Per Gallon of Pure Substance 60° F. 30" Hg		Cu. Ft. of Gas Per Gallon
CH_4 Methane 4.65	×	82.13	=	3.819
C_2H_6 Ethane.....12.20	×	47.04	=	5.759
CO_2 Carbon Dioxide .65		..		
C_3H_8 Propane....32.15	×	38.46	=	12.384
C_4H_{10} Butane 44.10	×	32.73	=	14.434
C_5H_{12} Pentane, etc 6.25	×	27.83	=	1.739
				38.115

*From Day's Handbook.

As a further check upon the actual results obtained, a closer study of the fractional analysis of both the gasoline and the vapor reveals that the figure obtained can be verified in several ways. By converting the figures shown in the average analysis of vapors evaporated to gallons of gasoline lost, a figure of 350.9 is obtained against the actual figure by gauging of 350 gallons. This is computed in the following manner:

Calculations from An Average Analysis of Vapors Evaporated 60° F. 760 M. M.

	% VOLUME		Cubic Feet of Gas Based on Actual Meter Reading 60° F. 760 M.M. Total Gas Measured		Volume of Fraction		Volume of Vapor per Gal. of No. mal Substance		GALS.
Methane	4.65	×	13,142	=	611.0	÷	47.04	=	34.1
Ethane	12.20	×	13,142	=	1,603.3	÷	38.46	=	109.9
Carbon Dioxide	.65	×	13,142	=	85.3	÷	32.73	=	177.1
Propane	32.15	×	13,142	=	4,225.1	÷	27.83	=	29.8
Butane	44.10	×	13,142	=	5,795.6				
Pentane, etc.	6.25	×	13,142	=	821.7				
	100.00%				13,142.0				350.9

Note: Methane and carbon dioxide do not appear in the fractional analysis of the liquid gasoline; therefore no attention was given to these factors in the above calculations.

Now, by converting the liquid contents of the tank as shown in the Carbide Company's analysis both before and after the tests to the gaseous state, a check upon the meter reading may be obtained and might also prove to be of interest.

RESULTS FROM FRACTIONAL ANALYSIS OF NATURAL GASOLINE IN CUBIC FEET OF GAS AT °60 F. AND 760 MM.

Before Test	After Test
8320 gls=236,340 cu ft	7970 gls=223,058.7 cu ft
Cu. ft. per gal.=28.4	Cu. ft. per gal.=27.99

Loss from calculations 13,281.3 cu. ft.

The number of cubic feet as shown above was calculated by converting the various compounds from the percent weight to the per cent by volume in the gaseous state. An indication would be the case of ethane before the test. Ethane = 0.6% wt. x 44,761.6 lbs. the total wt. of the contents of the tank = 286.6 lbs. Ethane.

$$\frac{268.6 \text{ lbs.} \times 359 \text{ cu. ft. per lb. mol.}}{30 \text{ molecular wt. Ethane}} = 3214.2$$

cu. ft. of Ethane of 0°—760 M.M.

$$\frac{3214.2 \times 288.5}{273} = 3396.7 \text{ cu. ft. of Ethane}$$

at 60° F. 760 M.M.

By using this number of cubic feet and applying it to the average calculated composition of the gas in the manner shown previously, a figure of the following nature is obtained.

AVERAGE ANALYSIS OF VAPORS EVAPORATED REDUCED TO GALLONS

	% Volume		Cu. Ft. Per Constituent as Calculated from 13,281.3 cu. ft. 760 M.M.	Gals. at 60° F.
Methane	4.65	=	617.6	....
Ethane	12.20	=	1,620.3	34.4
Carbon Dioxide	.65	=	86.4	...
Propane	32.15	=	4,269.9	111.0
Butane	44.10	=	5,857.0	178.9
Pentane, etc.	6.25	=	830.1	29.9
	100.00		13,281.3	354.2

With the experimental data showing a loss of 50 gallons of gasoline containing 37.6 cubic feet per gallon and the calculated results from the analysis showing 354.2 gallons containing 37.5 per cubic foot per gallon, the value of these fractionations is readily apparent. These figures are also based on normal compounds and while we have no assurance that they are normal, the results show in this connection that they are quite reliable. As stated at the start of this paper, this experiment was made with a definite object in mind and not to cover the entire subject. It would have been very interesting if time had been available to carry out this evaporation to a point where additional valuable information might be secured. However, it does conclusively prove the value of the fractional analysis and also the characteristics of the gasoline evaporated in this specific manner.

It is to be noted that only 4.2 per cent of the gasoline was evaporated and that the fractional analysis of the vapors evolved, shows they consist chiefly of propane and butane. The figure of 37.6 cubic feet of vapor obtained from the evaporation of one gallon of gasoline, therefore, is applicable only to that proportion of the gasoline evaporated.

Another point worthy of notice is that during the evaporation or weathering of the gasoline contained in the tank, appreciable percentages of the desirable components of the natural gasoline were lost.

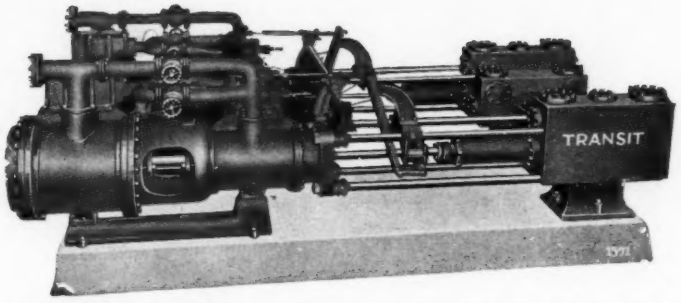
Chatham, Ont. — Beaver Refining Company, at Coutts, Alberta, recently completed the installation of a Foster type tubular retort and has the unit in operation. The new equipment eliminates the use of the older type of shell still equipment.

Detroit, Michigan, offices of the White Star Refining Company have recently been moved to the new White Star Office Building at 903-917 West Grand Boulevard.

DATA TAKEN DURING ACTUAL EVAPORATION FROM THE STORAGE TANK.

Time P. M.	Tank Ft.	Gauge In.	Gals. as Read	Temp. of Gaso.	Press on Tank	Corr. Gals.	Loss Gals.	Gas Meter	Cu. Ft. as Passed Between Readings	Temp. of Gas	Total Corr. Volume Gas in Cu. Ft.	Cu. Ft. Gal. Gaso. Evaporated
2:30	6	10¾	8427	75.5	27.5	8320	0	16252	0	102°	0	0
3:00	6	10-11/16	8422	75.5	24.2	8315	5	16400	148	99°	137	27.4
4:00	6	10⅜	8396	75.5	21.6	8290	30	17630	1230	91°	1289	43.0
5:00	6	9⅞	8355	75.5	20.5	8245	75	18970	1340	83°	2463	35.2
6:00	6	9⅝	8333	75.0	19.5	8230	90	19950	980	76°	3407	37.8
				(No Readings 7:00 P. M. to 8:00 A. M.)								
A. M.				Average Temperature during this Period=58° F								
8:00	6	6⅞	8089	68.0	13.0	8033	287	28000	8050	57°	11472	39.8
9:00	6	6¾	8077	68.0	12.5	8016	304	28299	299	64°	11771	38.7
10:00	6	6½	8054	68.0	12.5	7997	323	28794	495	76°	12258	37.9
11:00	6	6¾	8031	67.0	12.0	7987	333	29300	506	86°	12745	38.3
12:00	6	6⅛	8019	67.0	12.0	7970	350	29760	460	92°	13180	37.7

SUCCESSFUL REFINING



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The fluid end of the above pump, however, is perfectly all right for 1000 lbs. working pressure, and will handle hot oil up to 1000° F.

Successful refining depends on whether or not you waste or save in your refining operation.

In your cracking plant, for instance, if you are operating a TRANSIT Hot Oil Pump, where the valves are very close to the cylinders, reducing the clearance to a minimum, you have the ideal condition for economical operation. Every stroke puts a cylinder full of oil through the coils.

If, however, you happen to have a pump that has the valves located some distance from the cylinders, making a lot of clearance, then you are operating at a decided disadvantage. Every stroke means that there is a cylinder full of steam used all right, but you are putting through the coils only from 30 to 50% of the fluid cylinder displacement. The result is a big waste of steam.

You will make gasoline, but it will cost you more money to make it than it costs the refiner with a TRANSIT Hot Oil Pump.

If you are contemplating the installation of a cracking process, see to it that a TRANSIT PUMP is specified.

In addition to being an economical unit, it is absolutely safe and that means a lot to your big refinery investment.

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Forgotten Chapter of Oil History

By HARRY BOTSFORD

IN oil field histology many points are in dispute. Some of these points may never be cleared up. Two phases, however, are rather clearly defined: that Drake actually drilled the first artesian oil well on August 28th, 1859; and that within a year thousands and thousands of barrels of oil were being produced in the Pennsylvania fields. The question naturally arises: How was the oil absorbed, considering that such a short time had elapsed since the production of crude petroleum in paying quantities? Who bought the crude petroleum? And why? How was the market established for this new commodity?

And thereby hangs a tale. Possibly the story is one of the most interesting of all the stories of the oil fields. Certainly it deals with one of the most important phases of the new industry. Had certain conditions not been just so it seems reasonable to assume that the spread of the search for oil would have been seriously retarded and perhaps delayed for at least a decade.

It may surprise oil men to know that prior to 1859 there existed in Scotland a first-class refinery, owned by one James Young, a canny chemist of no small ability. Young's refinery used his own patented process for making lubricants and illuminants from shale, peat and coal. His business was a very prosperous one and he guarded his process jealously. Sworn testimony delivered by Doctor Young when suing an infringer was to the effect that his annual profits were approximately 300,000 pounds a year—about a million and a half dollars. So we see that in Britain, at least, refining was an established industry before Drake ever heard of crude petroleum that seeped from marshy ground along the banks of Oil Creek in Northwestern Pennsylvania.

It was inevitable that the refining of oil should come to America. In Canada, in West Virginia and other places coal was mined which gave every evidence of containing the same volume of oil secured by Young from Scotch shale. The mechanical age was only a minor influence in the early fifties; only a million barrels of illuminants and lubricants were produced to satisfy the existing demand; part of this was sperm oil, part of it lard oil and no small proportion of it consisted of tallow. There did exist, however, a demand for a proper illuminant, something superior to sperm oil—something a bit cheaper and more convenient.

Demand for Illuminant

"Coal oil" seemed to be the answer. A demand existed even before a product was ready to fill that demand. Abraham Gesner was, unquestionably, the first American to produce an illuminating oil from bituminous materials. It is a matter of record that in August of 1846, at a public lecture in Prince Edward's Island attended by less than two score bored citizens, that Gesner actually burned in crude lamps a species of "coal oil" and he lectured learnedly on the subject. To date Young, with true commercial insight, had refused to permit others to use his process even though some very high bids were made by certain American concerns. Gesner developed his own process, patented it in March of 1855 (Patent No. 12612) and passed his rights on to the North American Kerosene Gaslight Company with large works at Newton Creek, Long Island, where a passable "coal oil" was made from Scotch "boghead" coal. For some reason, however, the agents of the company had considerable difficulty in disposing of the product.

The public was slow to respond to the manifest virtues of the "coal oil," but, as more concerns entered the field, the demand grew slowly but steadily. One of the major factors in the growth of the use of "coal oil" was the discovery of a safe and practicable lamp in which to burn it. This phase of the matter is a story in itself and a mighty interesting one too.

The Downer Kerosene Oil Company, started in 1857, made mineral oils from Albertite coal mined in New Brunswick; the Downer plant was a large one and cost to erect $500,000. It was located in Boston and at Portland, Maine, the same organization had a smaller refinery where only the best of Scotch coals were refined. In 1859 (prior to date on which the first artesian oil well was drilled, mind you!) six refineries existed in Pittsburgh, alone. These plants were not small, backyard affairs, but they were large in capacity, well managed and they represented a considerable investment. The Luesco Company, for example, had a distilling capacity of 6,000 gallons of crude oil a day; they operated 10 large revolving retorts and sixteen 2,000 gallon stills.

Fifty-Three Refineries

We now have a situation where previous to the drilling of the first artesian well, "coal oil" refineries to the number of fifty-three existed. These refineries had, to a large extent, pioneered the way for the new mineral in liquid form about to be released by Edwin L. Drake at Titusville, Pennsylvania; these refineries had pioneered, to no inconsiderable extent, the marketing of their products, illuminants and lubricants.

Previous to the drilling of the Drake well it appears that of these fifty-three refineries only one had ever attempted to refine crude petroleum. At Tarentum, near Pittsburgh, several salt wells had been ruined as such by a seepage of petroleum. One of the owners of a salt well so affected was Samuel M. Kier, a druggist of Pittsburgh. Kier turned a liability into an asset when he bottled the petroleum, placed an imposing label on the bottle and sold the contents as a medicine guaranteed to cure every ill from ingrowing toenails to senile decay. He was faced with an over production. The medicine did not sell readily at fifty cents for a half-pint bottle and being thrifty he decided that possibly he could refine the petroleum himself. With this in view he built a crude still and actually did some refining, securing a "wine-colored distil-

THE FIRST PIPE LINE STATION. THE INTRODUCTION OF PIPE LINES FOR THE TRANSPORTATION OF OIL DID MUCH TO STIMULATE REFINING BY SHUTTING DOWN OVERHEAD.

Air Ejectors for HIGH Vacuum

Elliott booster ejector designed to compress 1100 lbs. of vapor per hour from a pressure of 7 mm., absolute, to 50 mm., absolute.

Elliott Steam Jet Ejectors, in service in many oil refineries in this country and abroad, are demonstrating the advantages of high vacuum distillation.

Each of these ejectors was designed to fit the conditions peculiar to the particular still it is serving.

In some refineries, they are removing fixed gases only, and in others a mixture of fixed gases and steam. Some of these ejectors are accomplishing a compression of only 1.5 inches of mercury and some as much as 25 pounds, with suction pressures as low as 3 mm. of mercury, absolute.

A wealth of experience in the application of high vacuum equipment to oil refining processes has been accumulated, and is at your service.

In addition to high vacuum or booster ejectors, Elliott Company also manufactures complete vacuum equipment for lubricating oil stills.

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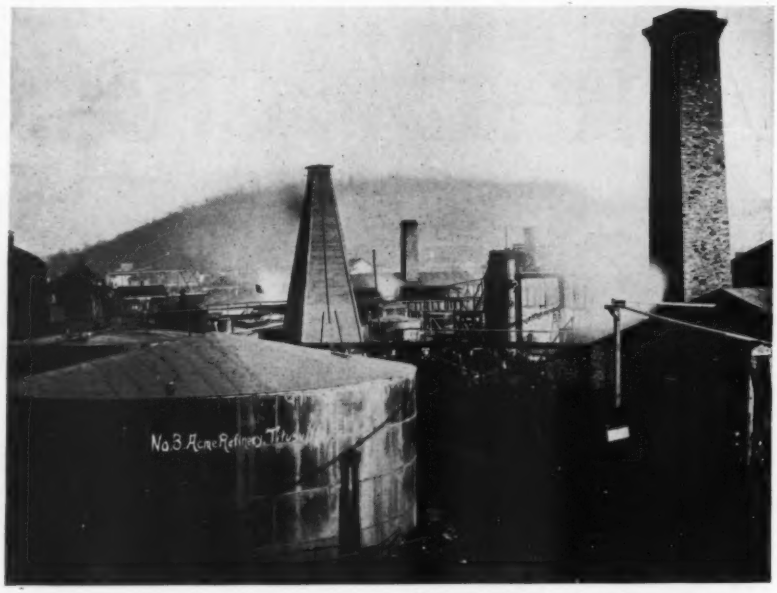
late" which he called "Carbon Oil" and which burned well but with a terrific odor that made it impossible as a commercial product. One Colonel C. A. Ferris heard of the petroleum seepage into the salt wells of Tarentum and made an investigation and secured nine barrels of the product which he sold to a refinery for $275.19; later in the year of 1858 he again made a shipment of oil (19 barrels) to New York and for this shipment he received $581.47. This one refinery, so it appears, was the only one that had had any experience whatever in handling crude petroleum and it is evident that they put but scant importance on the experiment because, it is likely, of the shortage of the supply.

August 28th, 1859 the first artesian well started to produce. It produced at the rate of 20 barrels per day. Other wells were promptly drilled in along the banks of Oil Creek and almost without exception their initial production exceeded that of the Drake well.

Converted Plants

The refiners first viewed the discovery of a natural liquid mineral oil with no alarm whatever. It was their opinion that the pool was purely local and would quickly exhaust itself. However when the production showed signs of increasing they quickly realized that their usefulness as refiners of coal was at an end. A few immediately went out of business; others experimented with the new product in their stills and it was not long before they discovered that it was possible, with some mechanical changes, to produce a most excellent grade of illuminant and lubricant from the crude petroleum right in their plants already established.

Hitherto their production of refined products had been slow and rather expensive. At one clip, so to speak, they stimulated production and cut down on operating expenses. This naturally involved a serious and sustained marketing program, an educational process that involved not only the dealer but the user.



THIS VIEW OF THE ACME REFINERY WILL GIVE AN IDEA OF THE TYPE OF APPARATUS. THIS REFINERY BURNED DOWN—ONE OF THE FIRST OIL REINERY FIRES.

The fact that the "coal oil" refineries immediately absorbed the entire output of petroleum; the fact that they succeeded in merchandising their illuminants and lubricants—these factors encouraged the further efforts of the producers and gave them substantial hope that a stable and ready market would unquestionably exist for the supply of petroleum they anticipated their efforts would bring forth.

Had not these refineries existed; had the art and science of basic refining principles been undiscovered at the time the Drake well was drilled, years and years would undoubtedly have elapsed before drilling operations would have widened in scope. Perhaps a decade or even more might have elapsed before drilling operations extended beyond the narrow limits of the field in which the Drake well was drilled.

Marketing Difficulties

To believe, however that the early refiners found a ready market for all their wares; or to believe that their sales-problems were almost solved by an existing but incoherent and confused demand would be beyond the bounds of strict truth. As a matter of fact the early refiners experienced no end of difficulties. Some operated for a period of fourteen years under license of the Young patents; others adopted the Downer process; some used the Gesner process and others stumbled along using their own methods. Fires were common and more than one of the early refineries went up in a pillar of black smoke and hungry flame. Bankers were none too kind to those behind the very new industry and financial problems were frequent. A shortage of skilled refinery workers kept many of the plants from carrying out the extension program they felt justified in planning.

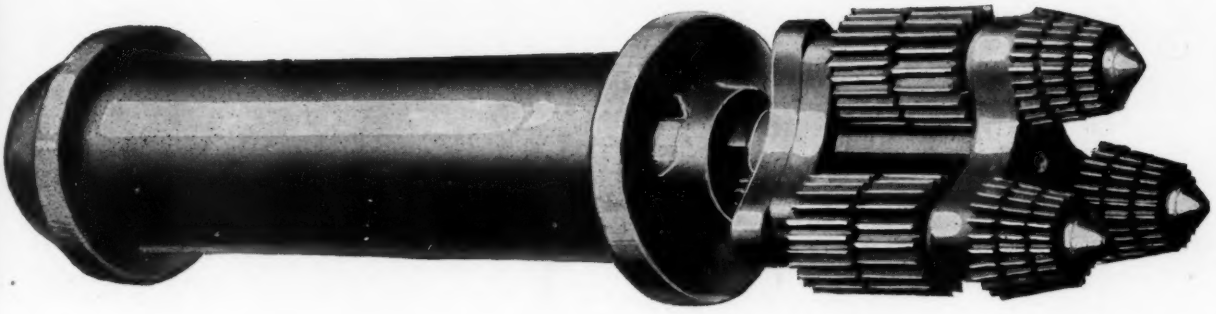
The early lamps were none too safe. Accidents were frequent; unpleasant fatalities involving women and children and the loss of property. The newspapers, unfortunately, featured such events and in certain quarters a decided prejudice was set up against the use of kerosene as an illuminant.

Indeed, so strong was this prejudice, so lusty this bias, that in 1868-69 the government of the United States stood squarely behind a law that forbade the use of petroleum products as an illuminant on any vessel or passenger steamer that carried passengers. Certain of our States, harkening to this type of legislation, passed laws that prohibited the use of petroleum products as illuminants on passenger trains. It is not entirely fair

(Continued on page 104.)

ONE OF THE EARLY REFINERIES LOCATED AT TITUSVILLE, PENNSYLVANIA

Go after scale with a double-power motor and husky cutter head



For removing the hard and heavy scale in tube stills, a cleaner with a powerful motor and efficient cutter head is imperative.

The Liberty Tandem-type Cleaner, illustrated above uses a two-cylinder motor, having two cylinders of the size employed in the ordinary tube cleaner placed one in front of the other, thus doubling the power obtained from the motor. The result is a powerful turning effort which drives the rugged and efficient "SF" head to maximum advantage, obtaining speedy and unfaltering removal of even the most stubborn scale.

The Liberty Type "SF" Cutting Head is husky and rugged, of simple construction and easily taken apart for the renewal of cutters. It is especially adapted for severe scale conditions. Can be supplied with any type of Liberty Cleaner.

If you are looking for faster and more powerful tube cleaning equipment, investigate the Tandem-type Cleaner with "SF" head.

Described in Bulletin Z-2, copy on request.

Z-1046

Liberty Manufacturing Co.
Jeannette, Pa.

How Coke Is Handed at the Marland Refinery

By H. G. OSBORN
Assistant Superintendent Marland Refinery

SEVERAL years ago when the Armour Packing Company was at the zenith of its expansion, their advertising copy carried a list of the products manufactured. The list was startlingly large and apparently consumed every conceivable portion of the animal. The advertising concluded with the statement that the packing company was "utilizing everything out of the hog but the squeal."

The modern refinery must, to compete successfully, extract from a barrel of crude "everything but the squeal," which in its case is the inevitable loss in the form of very light hydrocarbon vapors.

One of the by-products formerly of very little value to the refiner, but at present of some importance, is petroleum coke. Referring to former articles on the operation of the Marland refinery it was pointed out that in the production of gasoline from heavy oils such as gas oil and fuel oil, there was formed petroleum coke. This is true in all cracking processes in varying degrees. For example, our Fleming pressure stills produce per day approximately three tons of coke, our Cross stills two tons and our Dubbs stills 225 tons, or a total of some 230 tons daily.

The disposal problem alone in connection with this coke is a large one. It must be removed from the immediate vicinity of the stills, stored and later marketed. For the purpose of removal Marland Company has installed approximately one-half mile of industrial railroad, operates two locomotives and about twelve coke cars. The coke is collected by means of conveyors from various points where it is produced, and hauled to a storage area south of the refinery. Before reaching the storage ground the trains climb a trestle until they are approximately twenty feet above the ground. The cars are opened and the coke dumped onto the ground.

Petroleum coke finds extensive use in two different fields, i.e., power plant consumption and domestic use. In the first instance the coke can be burned in either of two ways: (1) pulverized to a maximum size of approximately one-fourth inch, in which condition it is fed by the use of compressed air or steam as a fine dust into boiler where combustion takes place; (2) in lump form on chain grate stokers. The stokers are simply continuous chains, operating similarly to the track of a tractor or tank. The coke fed onto the chain grate is moved slowly from the front to the rear of the boiler, during which time combustion takes place, and by the time the chain turns under and begins its return circuit combustion is complete and the ashes fall below the boiler.

The domestic uses of coke, either in fire boxes, stoves or furnaces of one type or another, are familiar to all of us.

At the present time Marland Company has contracts for some 30,000 tons of coke for industrial uses in power plants. It is important that this coke be absolutely free from any foreign matter, such as dirt, iron, brick-bats, etc. In order to accomplish this end considerable money has been expended on the installation of electro magnetic pulleys. The coke, as shown in the attached illustration, is loaded by a crane equipped with a chain-shell bucket into a hopper, which assures the even flow of the coke over the conveying belt. The pulley at the end of this conveyor, over which the belt travels, is connected with an electric generator sufficiently powerful to create a magnetic field even through the belt and a fairly thick coke bed. In this way any iron in the coke, on passing over the pulley, is abstracted and clings to the belt until it passes back out of the magnetic field, when it drops off. From this first conveyor the coke falls into a rotary screen approximately three inches in diameter and fifteen inches long, set on a slight slope. This screen is simply a cylinder, the sides of which are perforated with various sized holes. It revolves slowly and the coke up to two and one-half inches falls through the orifices into a hopper, which feeds it automatically onto a second conveyor. This conveyor is equipped with a electro magnetic pulley similar to that previously described and assures the extraction from the coke of any iron which may possibly have escaped the first magnetic field. This conveyor discharges the coke directly into the standard railroad cars.

Retracing our steps a moment, the coke which entered this screen and was too large to pass through the perforations, runs out the open end in the form of lump coke into storage provided. This is the coke utilized for domestic fuel. It is periodically loaded with the crane into cars.

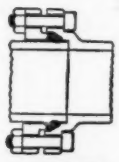
A comparison of the heating value of coke with some better known products may be of interest.

Character of Fuel	Volatile Matter	Ash	Heat-Value B.T.U.
Anthracite Coal	6.21	15.5	14,900
Bituminus Coal, Pa....	36.42	5.93	14,947
Oak Wood			8,316
Fuel Oil, W. Va.....			18,000
Marland Pet. Coke....	12.66	0.62	15,864

From the above table it will be seen that

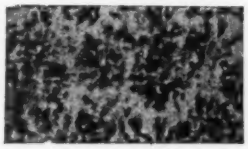
(Continued on page 102.)

SIMPLEX CAST IRON CONDENSER PIPING

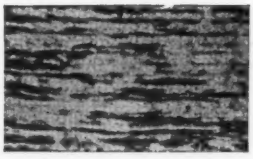


"ONE FLANGE IS LOOSE"

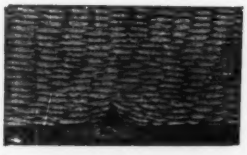
COATS ITSELF



Photomicrograph of cast iron, much enlarged, showing granular structure.



Photomicrograph of wrought iron, much enlarged, showing fibrous structure.



A piece of sheet steel, much enlarged, showing surface and sectional structure with a typical pit.

AUTHENTIC data from over 250 years of service prove that cast iron becomes coated with rust but remains practically unimpaired in weight and strength under conditions that are fatal to other kinds of metal.

Scientists believe this phenomena due to the microscopic structure of cast iron —a structure of the same granular or crystalline form as found in the iron ore from which it is made and which has laid unimpaired in the ground for untold centuries. Cast iron rusts on the surface, but the corrosive agent fails to break the natural mechanical bond between the irregular shaped granules, further oxygen is excluded by the first rust coating, and therefore corrosion stops. Cast iron literally coats itself.

In place of the interlocked grains or crystals of cast iron, wrought iron and steel are of a fibrous and, in thinly rolled steel, of a laminated structure, with distinct leaves overlapping each other. As corrosion takes place, these leaves or fibres scale off, constantly presenting a fresh surface to the corrosive agent.

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Mechanical Details of Certain Types Of Fractionating Columns

By GEORGE REID
Associate Editor

ALTHOUGH the refining industry has witnessed noteworthy improvements in all types of equipment during the last few years and in all departments, no other class of equipment has undergone such rapid and progressive development as has that of fractionation. The tower has developed in the last few years from the hollow shell knockout box, through the baffle plate and pan stages, into a highly efficient, close cutting, selective, partial condensing (fractional condensation), evaporative and dephlegmative column, which is usually designated by the term "bubble tower."

In the early days of bubble type tower development there was a marked tendency on the part of individual designers to install compact towers of small dimensions, working on the theory, perhaps, that the bubble cap device was so good that but few of them were sufficient and that those few could be packed tightly into a shell of small size. This contributed largely to the failure of early towers to perform satisfactorily, and constituted the first error in design. The writer has seen several installations of bubble towers where the original small columns were torn out and one placed on top of another, in one instance three small columns stacked together, thus building a fractionating column of, at least, decent dimensions.

Soon, the experimenters found that the large rangy columns, packed with 15 to 30 trays of bubble caps, running from 15 to 30, and more, caps per tray, would be productive of such efficiencies as desired. Thus the first corrective step in tower design was to make them *big* enough. No arbitrary statements can be made as to the proper dimensions of the "universal" bubble tower, for much depends upon the type of oil to be distilled and the volume and type of vapors to be fractionated, condensed, and separated in the specific installation. As this discussion is to be informal and void of dry technology, it is perhaps in line to quote here the rule of one successful designer of very efficient equipment: "Figure them out scientifically and mathematically, then double everything." That appears to be about as reliable information as any obtainable. There have been few instances indeed where the bubble tower was reached in size after installation.

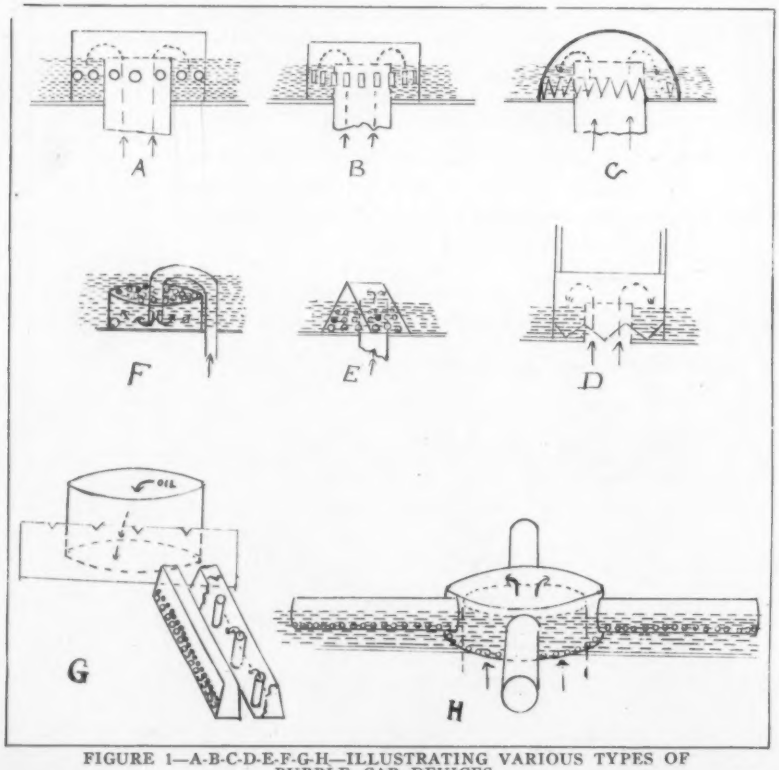

FIGURE 1—A-B-C-D-E-F-G-H—ILLUSTRATING VARIOUS TYPES OF BUBBLE CAP DEVICES.

Too Efficient

There have been instances, however, where newly installed fractionating equipment of the type discussed was too efficient under certain conditions as to market or plant methods. The story is told of a certain major refining plant close to the city of New York, where the installed towers when placed in operation would yield no marketable kerosene, but at former operating temperatures produced a gasoline of U. S. Motor specifications, 437 End Point, and a reflux, which should have been kerosene, of 450 degrees F. Initial Boiling Point, which could not be marketed as kerosene for obvious reasons. It was necessary then to remove a few plates and bubble caps to decrease the efficiency of the tower. Kerosene being desired, not to say demanded, of this plant, this experience constitutes one of the few instances where a "negative gap" was unwelcome. The present prospective purchaser of fractionation equipment immediately asks, "Will you guarantee to 'gap' the crude, to eliminate overlapping of distillation range?"

There are a few towers being marketed at present which "gap" the product passed through them when in operation, producing a reflux material of higher initial boiling point than the end point of the overhead of finished distillate. Operations with this type of tower assure the stripping of all gasoline from the crude, a maximum skimming percentage in one heating usually, with no rerunning. Several installations of this type are operating at present with success and the practice of negative gapping will soon become extensively required as essential to efficient separation and fractionation. Pause to compare such operation with that of the efficiency of five years ago. At present, the best refining practice consists of tubular retort distillation with complete separation of all desired fractions in one tower.

Bubble Devices

Probably because human nature desires to express itself differently, the bubble device or cap has been subjected to about as many and various designs and shapes as was the old baf-

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fle or shell tower. The old tower was packed with everything from pebbles to Ford parts—crocks, bricks, metal and glass balls, tin cans—and provided with baffles and plates, perforated with eighth-inch holes up to 4-inch gaps—and plate of various metals and alloys, and later hooked up in series of 4, 6 and 8, with perhaps each shell packed or constructed differently. The designs of bubble cap devices have been almost as numerous and the number is still growing.

Figure 1, sketches A-B-C-D-E-F-G-H illustrates some of the various types of bubble cap devices that the writer has seen personally. Sketches A-B-C-D and E of Figure 1 are merely indicators of five means of securing identical results, for in each case the vapors derived from the retort entering the tower are caused to enter nipples (which are either flush with the bottom of the plate or extend below it an inch or so) then to impinge upon a solid interior of the bell covering, where they are sharply deflected downward suffering a reduction in velocity, and then to pass through a layer of previously condensed liquid. In this manner the heavier molecules which are carried out of the crude being distilled by mechanical entrainment in the lighter vapors are both knocked out of the grasp of the carriers and selectively absorbed by the layer of liquid through which the vapor must pass at reduced velocity. The principles of re-vaporation, partial condensation, dephlegmation, selectivity and fractionation are brought into play in the tower equipped with such devices. Figure 1, Sketch F, shows a different manner of doing the same work, but in effect, doing it backward. The vapors are carried through the plate, up and over the inverted bell, through the bell top and caused to impinge upon the plate surface. The vapors then rise through numerous small perforations in the bell top and pass through a layer of surrounding liquid, then upward to the next plate. The entrained oil particles, or heavy condensed distillate accumulates in the bell and passes outside through a small hole or perforation to dissolve in the surrounding liquid condensate. Vapor pressure, it is said, is sufficient when operating, to keep the liquid condensates on the plate outside of the bell caps.

Sketch H, Figure 1, presents still another idea embracing only one large bubble device per plate or tray. The vapors strike the bell top, are deflected downward, exiting through very small perforations around the bottom circumference of the bell cap, or through larger perforations in the bottom of the four radiating arms or extensions. The ends of the four extending nipples are plugged, and the radiating nipples are partially submerged in liquid condensate—as is the bell cap proper.

The drawing G, Figure 1, illustrates one of the few types of bubble caps where one large bell handles the vapors conducted to it from two or more nipples. This particular design is peculiar to certain Southwestern equipment. The level of condensate accumulating on each plate is regulated by wires, over which the liquid flows and passes into the down spout or overflow pipe conducting it to the plate below. The Weirs are notched to direct the flow of all oil between the alleys formed by the long bubble cap devices.

Use of Wire

There are other similar devices incorporated in bubble tower design, all of which produce similar results and efficiencies. Certain designers attempting to reduce construction costs have eliminated bell caps and plates altogether, using heavy wire screening of fine mesh and liquid level control devices, or sheet iron plates perforated with very small holes, or a combination of plates and screens,—all of which are efficient to a certain extent, especially where a condensed liquid level is maintained through which the rising vapors must pass.

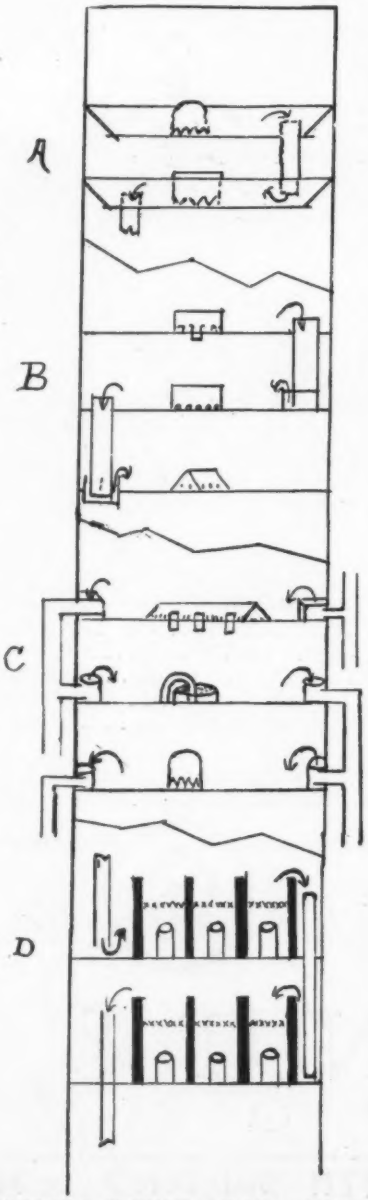


FIGURE 2—SECTION A-B-C-D. ILLUSTRATING CERTAIN TYPES OF INSIDE AND OUTSIDE OVERFLOW OR LIQUID LEVEL CONTROL DEVICES.

It has been virtually agreed among refiners that the design, shape or "style" of bubble cap has little effect upon the efficiency of the towers, but that it is essential only that they provide for a reduction of velocity after the vapors strike the impinging surface, and that there be provided a sufficient number of caps and trays—returning again to the tower of larger dimensions.

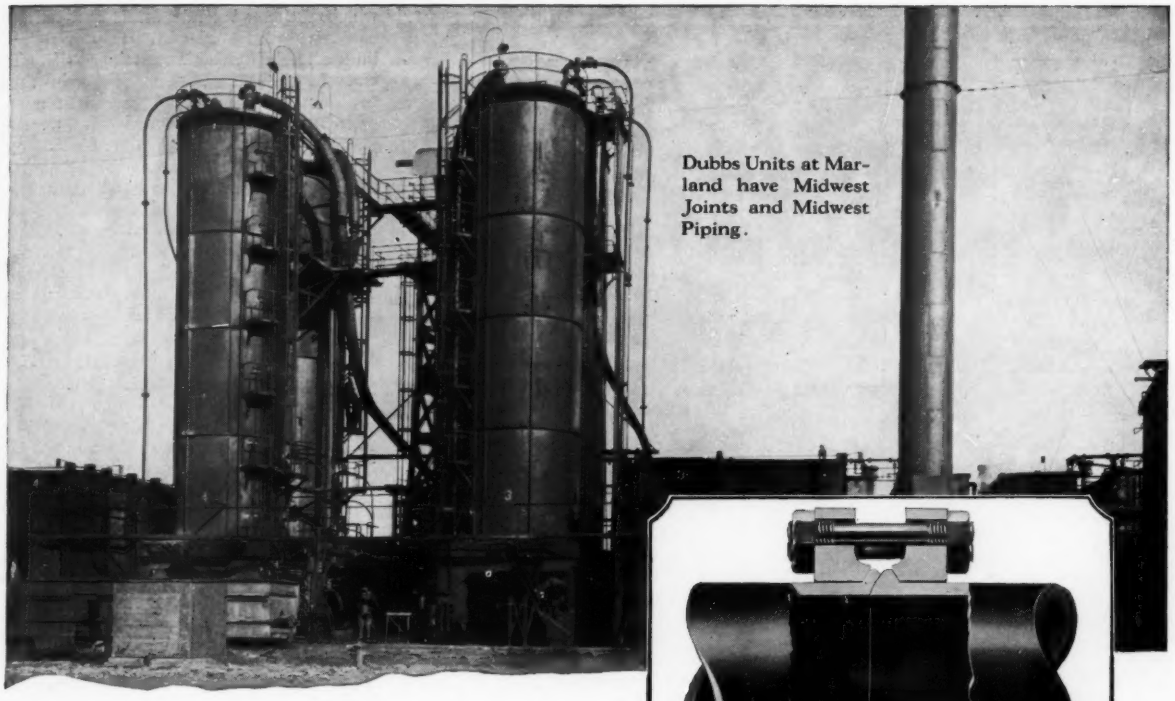
Liquid Level Control

Figure 2, Section A. B. C. D. illustrates a few of the methods incorporated in bubble towers for control of liquid level of condensates on each tray or plate. A. B. and D. are designs for control inside of the tower shell. C. is one method of removal of condensate and control of flow from one plate to another where such is practiced outside of the tower. The advantage of conducting such condensates outside of the tower can be either returned to the tower or, if desirable, then can be conducted to storage as finished products. The down spout or level control was not perfected in the early designs of bubble towers but the condensate accumulating on each plate was merely allowed to overflow through a hole cut in the plate. This practice permitted certain portions of the vapors to escape dephlegmation in the bubbling device and deprived them of the benefits to be received there,—tending, of course, to reduce the efficiency of the tower. The down spouts as shown in the figure corrected this error.

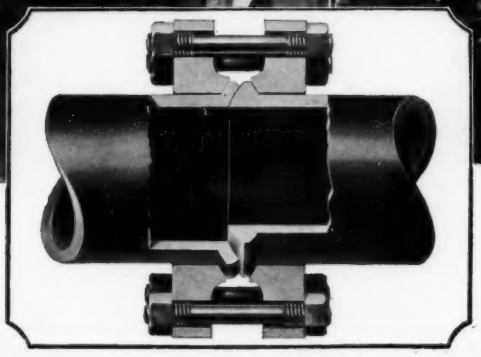
Section A, Figure 2, shows the downspout arrangement when the bell caps are placed in a pan. Section B. Figure 2 shows the overflow control device as designed using both the sunken and the built-up receiving cup. In section D, Figure 2, the tower design embraces the Weir level control in conjunction with relatively high liquid levels, open vapor nipples, and wire screening.

The installation of downspout overflows, or liquid level controllers, naturally lead to the endeavor of many refiners to remove these plate or tray condensates as finished streams. The multiple stream tower, however, has been in the minds of certain operators for some time, even previous to the perfection of the bubble tower. Such side streams were sought from the old pan type tower for example, and later from the Christman and Boner and Sheldon towers. The bubble tower, however, lends itself to multiple streams probably better than anything preceding it. As there is not space enough here for a discussion of certain multiple stream, multiple compartment bubble towers, from which six to eight finished major streams are derived,—all of the distillation and fractionation work being done with one tube still and one tower,—this practice will be discussed at some later writing.

In regard to the practice of removing the separate tray condensates as small



Dubbs Units at Marland have Midwest Joints and Midwest Piping.



Midwest Joints reduce refinery fire hazards

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Midwest Joints require no gaskets—there is nothing to blow out and cause the flash and fire that so frequently results in serious loss of property, loss of capacity and sometimes even loss of life.

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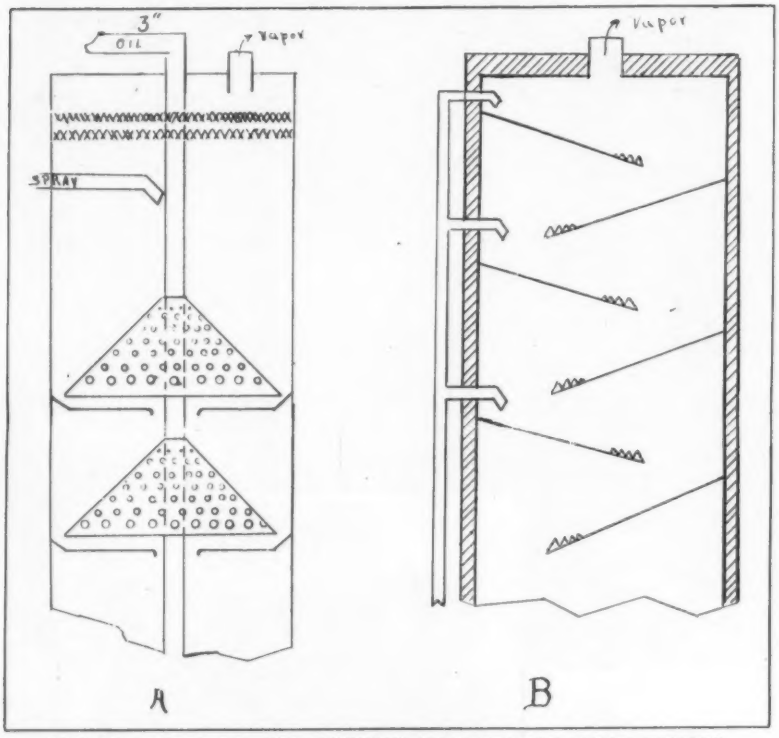


FIGURE 3—Sketch A-B—TWO RECYCLE OF OVERHEAD SPRAY TOWERS OF UNUSUAL DESIGN

side streams from conventional bubble towers, it has been found that in certain instances it can be done successfully. From certain experiments carried on by a Wichita Falls, Texas, refiner it was found that certain of the bubble tower plates would yield small side streams as finished products. The following tables give the specifications of the condensates removed or tested. Operating on 40 degrees A. P. I. gravity Hirchi Pool crude. Beginning samples of bubble plates at bottom plate as No. 1.

Plate	Grav.	I.B.P.	E.P.
1	47.5	227	540
2	47.7	225	528
3	48.5	223	494
4	49.5	217	465
5	50.0	220	447
6	50.4	212	435
7	51.0	209	422

Tower No. 2

Plate	Grav.	I.B.P.	E.P.
1	46.3	269	518
2	46.3	260	519
3	47.7	254	480
4	49.5	217	465
5	48.3	250	437
6	49.1	247	426
7	49.8	248	413

The foregoing tables indicate that perhaps eight of the fourteen tray streams examined were usable as finished products either in the preparation of U. S. Motor gasoline or a naphtha of 50/52—450 E.P. specifications.

There are numbers of refineries which, for various reasons, are not equipped with bubble towers, and which cling to the practice of recycling distillates over specially designed recycle towers as being just as good a method of eliminating re-running and securing economical operation. The recycle tower has much in its favor as compared to those tower types preceding it, though it is seldom that this type of installation is of as high efficiency as the bubble type tower. Overhead spraying is extensively practiced with rpactically all types of towers, especially the bubble type . The two designs, A and B illustrated in Figure 3, are especially constructed recycle type of fractionators. Sketch A, Figure 3, in operation has a circular coil at both top and bottom of the tower. The upper coil being above the two layers of wire screening. For convenience in drawing this equipment was omitted. The two layers of screening are placed above the spray inlet line, —which releases the recycle media against the three-inch oil line which acts also as a support for the numerous finely perforated conical baffles. The circular trays force the descending spray stock to converge to the center of the tower to fall upon the cone-like baffle below. The rising vapors secure intimate contact with the spray media through the arrangement of perforated baffles. The three inch oil line and two coils, top and bottom, are used to pass cool crude oil through the tower as an additional temperature control device.

Tower B, Figure 3, is provided with three points of entry for the recycle stock. In addition, this type of tower is provided with three points of entry at the bottom plates of the tower through which preheated crude oil is sprayed to enter the still through back trap or reflux lines after being partially stripped of light ends in the tower. The plates in this tower are solid, declining at about a 10 degree angle, and provided with a serrated edge over which the descending liquid flows. The plates extend across the tower about two thirds of its diameter; the saw toothed edges being about one and one-half inches in height. The still battery equipped with this type of tower produces a gasoline yield checking in percentage with laboratory analysis always within one half of one per cent.

The recycle type of tower and the bubble cap column are the two designs most extensively employed as fractionators in refining plants at present and compared to previous practice the present day results and efficiencies are most gratifying. It will be recalled that the refining fraternity borrowed the bubble type device from the alcohol industry some years ago,—and it may be interesting to note, in closing this discussion, that one of the latest installations of fractionating equipment embraces still another type of apparatus which also was borrowed from the alcohol industry. This equipment is known as the Schniedle centrifugal plates, and are extensively employed in the alcohol industry in the preparation of non-alcoholic beverages. Pictures of the plates show them to be simple in design,—consisting of two circular plates; the second plate with an annular opening being separated from the first by a series of thin baffles set at an angle. The velocity of the vapors is utilized to induce a centrifugal flow,—separating the heavier particles from the light. The plates are so arranged that the rising vapors are brought into intimate contact with descending recycle media.

There is not sufficient data at hand to compare efficiencies of the centrifugal plates with present efficiencies of bubble type towers.

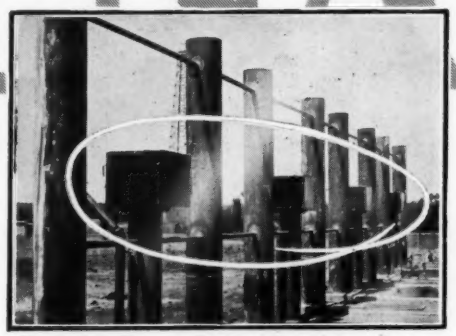
Junk Carbon Black Plant

Denver, Colo.—Carbon black plant of the Rio Blanco Carbon Company on White River structure, Rio Blanco County, Colorado, some 20 miles west of Meeker, was sold recently at auction by the sheriff of that county. A Denver junk dealer bought the plant for $1500. Gas for the plant was taken from a well on the White River structure which at one time had an open flow of 16,000,000 cubic feet per day, but the well caved in and exhausted the gas.

Utah Refinery Completes Holmes-Manley Unit

Salt Lake City, Utah.—Utah Oil Refining Company has completed the construction of two new units of the Holmes-Manley cracking process at its refinery which begins operation at once. Both units are 1000 barrel capacity. They will replace the old Burton cracking equipment which has been in operation at the plant for several years.

MENACE



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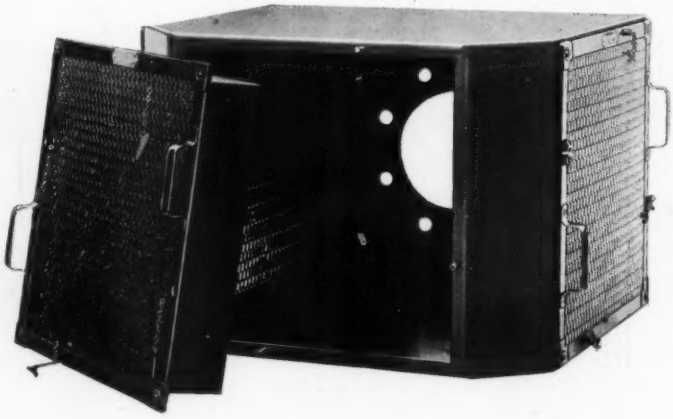

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The Use of Solvents for Dewaxing Parrafin-Base Crude Oil

By H. M. SMITH[1]

IN studying the chemistry of lubricating-oil fractions from so-called "paraffin-base" crudes, one of the first requisites is a method for the separation and removal of waxy material. A method utilizing solvents for this purpose is described in this report, together with preliminary experiments with solvents that led to its development. The solvents actually used are secondary butyl alcohol, acetone, and mixtures of these. Isopropyl alcohol was aslo studied.

In previous work on "intermediate-base" crude oil, following the work of Wyant and Marsh[2], acetone had been used for laboratory separations of oil and wax. When acetone was tried for the separation of the waxes and oils of "paraffin-base" crude, the volume of acetone required (80 parts to 1 part of oil) was found to be too great for large-scale work. For this reason the effectiveness of other solvents was studied; the separation by acetone, however, was used as a standard.

It is well known that ethyl alcohol dissolves hydrocarbon oils slightly, and that amyl alcohol is a very good solvent. It seemed probable therefore, that propyl or butyl alcohols could be used to advantage. The availability of isopropyl and secondary butyl alcohols, both made from the gases from petroleum cracking stills, led a study of their solvent action.

Isopropyl alcohol, CH_3—CHOH—CH_3, forms a constant boiling mixture (B. P. 80.4°C.) consisting of 91 per cent alcohol and 9 per cent water by volume. The commercial material tried in this work had approximately this composition.

Test-tube experiments indicated that the isopropyl alcohol as received did not offer any advantages over acetone, but after dehydrating with solid NaOH and anhydrous $CuSO_4$, it was an excellent solvent.

The secondary butyl alcohol, CH_3—CHOH—CH_2—CH_3, had a boiling range of 94° to 102°C. and had been dehydrated to about 98 per cent by volume. This alcohol appeared to dissolve the oil readily and to give good separations of the oil and wax.

Accordingly the following experiments were made with these two alcohols. The oil used was a paraffin-base crude, from which the gasoline had been distilled.

Sufficient solvent was added to 200 cc. of the oil to dissolve it at 50°C. the solution was then cooled to 0°C., and filtered by suction. The residium on the filter was again dissolved, cooled and filtered. The solvents were then removed by distillation from the oil and wax, and the respective recoveries determined.

The isopropyl alcohol offered no especial difficulties in this method, but the viscosity of the secondary butyl alcohol caused the filtration to be rather slow, and as an ice bath was not used around the funnel, the temperature rose somewhat and some of the wax went back into solution, causing high results for the oil and correspondingly low values for the wax. An additional difficulty was the tendency of the crystals to go through the filter due to their small size. The results of these experiments are as follows:

Since the dehydration of the isopropyl alcohol is rather inconvenient, further experiments were made with the secondary butyl alcohol. Two possibilities that suggested themselves were centrifuging and filtration in a filter press. Accordingly, portions of the oil and alcohol were fixed in the ratio of 1:1, 1:2 and 1:3. One hundred c.c. of each mixture were placed in graduated centrifuge tubes, warmed to complete solution and then chilled to 0°C. As soon as the prepared samples were thoroughly chilled they were centrifuged for five minutes to 3000 r.p.m. This threw the wax down in a very compact mass from all but the 1:1 mixture, which did not separate cleanly. The oil-solvent solution could be

Table 1—Results of Experiments, First Series

Solvent	Oil per cent	Wax per cent	Loss per cent
Acetone	74.1	18.1	7.8
Isopropyl alcohol (dehydrated)	68.1	21.4	11.5
Secondary butyl alcohol	82.4	8.3	9.3

The loss in these analyses is due to evaporation of a part of the light fractions of the oil when the solvent is distilled.

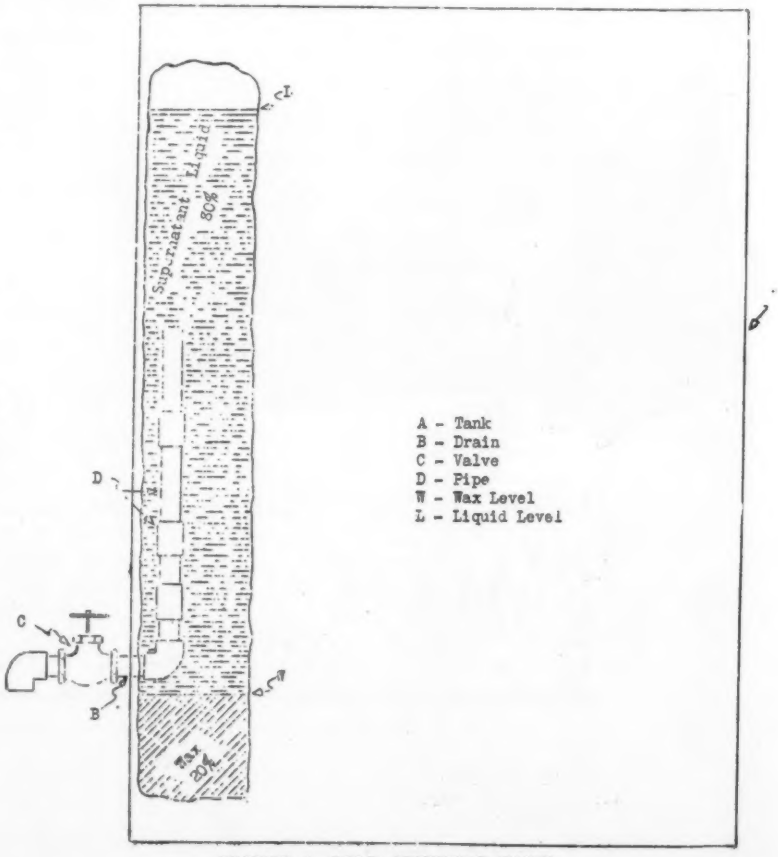

FIGURE 1—COLD SETTLING TANK

[1]Assistant petroleum chemist, Petroleum Experiment Station, Bartlesville, Oklahoma, Bureau of Mines, Depa tment of Commerce.

[2]Wyant, L. D., and Marsh, L. G., Paraffin Wax, Tech. Paper 368, 1925, 26 pp.

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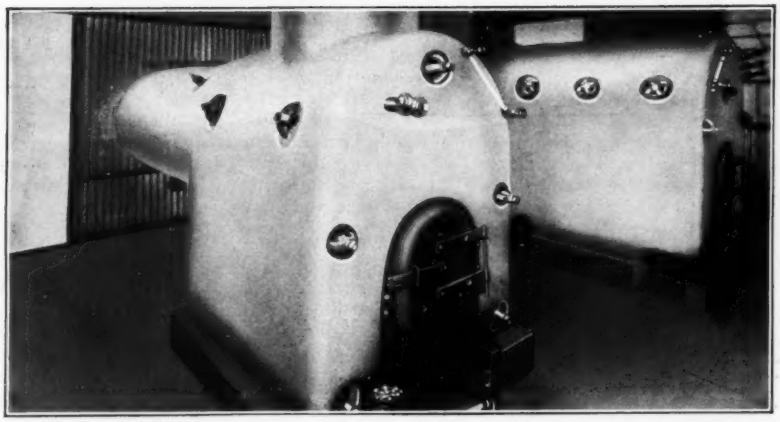

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readily decanted from the solid wax in the 1:2 and 1:3 mixtures. The percentage of wax in both these mixtures as indicated by the amount in the bottom of the tube corresponded very closely with the figures obtained by the acetone method.

Filtration

Filtration in a small experimental Shriver filter press using paper with cloth backing was not successful, as the pressure developed by the pump forced the small crystals through the filtering medium.

Cold Settling

Centrifuging was very successful, but because of limited equipment was very slow for the handling of large amounts; to overcome this difficulty cold settling was tried. Various mixtures of oil and solvents were pre pared, placed in Florence flasks and allowed to stand at a temperature of 1 to 2°C. for 36 hours. The mixtures used, and the observations made at the end of 36 hours are given in the following table.

Table 2.—Results of Experiments With Cold Settling.

Test No.	Oil, c.c.	Solvent Mixture: Sec. butyl alcohol c.c.	Solvent Mixture: Acetone c.c.	Precipitate: Size of particles	Precipitate: Condition dry or oily	Supernatant Liquid: Per cent	Supernatant Liquid: Condition
1	500	500	...	Very small	Dry	20	Cloudy
2	300	600	...	Small	Dry	65	Clear
3	500	250	250	Medium	Slightly oily	40	Clear
4	300	300	300	Medium	Slightly oily	75	Very clear
5	250	750	...	Very small	Dry	65	Clear
6	300	400	200	Medium	Dry	60	Very clear
7	300	200	400	None	Mush	65	Clear
8	300	300	*300	None	Mush	65	Cloudy

*Undehydrated alcohol.

Mixtures 4 and 6 gave the most promise considering the percentage and condition of the supernatant liquid; and accordingly the solutions indicated in Table 3 were made up and allowed to settle at 1 to 2°C. (34 to 36°F.)

Practical Separation of Oil and Wax

With regard to time and efficiency, mixture No. 10, Table 3, was the best, and it was used in the actual separation of wax from 50 gallons of the topped paraffin-base oil. The apparatus used in the process is shown in Figure 1. The drain, B, of ½-inch pipe, is inserted through the side of the 50-gallon tank, A, in such a position that 75 per cent of the contents can be drawn off. It is closed on the outside by a valve, C, and on the inside is built up with short pipe nipples and couplings, D, to a height well above the level taken by the settled wax. These nipples and couplings are screwed on loosely by hand, and can be removed as the liquid is drawn off.

Fifteen gallons of oil, 20 gallons of secondary butyl alcohol, and 10 gallons of acetone were thoroughly mixed in the tank, and then allowed to settle at 1 to 2°C (34-35°F). At the end of 24 hours, 30 gallons 66 2/3 per cent of clear supernatant liquid were drawn off, the wax level being approximately as shown by line W in figure 1. Twenty-five gallons of solvent were then added to the wax, the mixture stirred and again allowed to settle. At the end of 24 hours the entire supernatant liquid was drawn off.

Solvent Recovery

The solvent is removed from both the oil and wax by distillation with natural gas. A 5-liter flask in a bath of boiling water is a convenient still. A stream of natural gas is passed through the solution in the flask, and removes the solvent very rapidly. The recovered solvent may be used successfully for the wash mixture, especially when corrected for distillation loss by the addition of a small amount of acetone.

Altogether 140 kg. of gasoline-free oil were treated in this manner, and the recoveries were as follows: Oil, 72.8 per cent; wax, 25.7 per cent; loss, 1.5 per cent. The wax separated in this manner from this particular crude oil is very similar to yellow vaseline. The pour-point test of the dewaxed oil is 15° F., as against 25° F. for the gasoline free crude.

The above experiments indicate that seconardy butyl alcohol has possibilities as a solvent for the removal of wax from paraffin-base crudes. Its solvent properties may be utilized to their fullest exten, or they may be modified by the admixture of another solvent such as acetone. The manner in which it is used depends upon the method of dewaxing.

Table 3.—Results of Further Experiments With Cold Settling.

Test No.	Oil c.c.	First addition of solvent*: Secondary-butyl alcohol, c.c.	First addition of solvent*: Acetone, c.c.	First addition of solvent*: Settled in 24 hours, %	Second addition of solvent: Secondary-butyl alcohol, c.c.	Second addition of solvent: Acetone, c.c.	Second addition of solvent: Settled in 24 hours, %	Recovery: Oil %	Recovery: Wax %	Recovery: Loss %	Efficiency of recovery † %
11	300	300	300	75	300	300	75	61.5	29.8	8.7	85
9	800	800	400	60	800	400	75	70.2	22.4	7.4	95
10	600	800	400	75	800	400	75	70.2	21.8	8.0	95

*The supernatant liquid was drawn off of each mixture at the end of 24 hours, and the second addition of solvent used to work the wax crystals.

†Based on 74 per cent of oil obtained by acetone method (See Table 1).

Acknowledgements

This paper represents work done under a cooperative agreement between the U. S. Bureau of Mines, and the State of Oklahoma.

Acknowledgment is made to Mr. Henry M. Lyons of Henry L. Doherty Company, who suggested the use of these alcohols for this work, and to the Empire Refineries, Inc., who furnished the alcohol. Reports of Investigations, Bureau of Mines, Department of Commerce.

Panhandle Carbon Black Plants Use Residue Gas

Amarillo, Texas.—Two major sized carbon black plants are to be completed and put in operation about the end of the present year in the Texas Panhandle. Two other plants are being operated in the district, using residue gas from natural gasoline plants.

The Kosmos Carbon Company, subsidiary of the Union Carbon Company of Charleston, West Virginia, is building an eight-unit plant consisting of 32 burning houses per unit with a capacity of about 50,000,000 cubic feet of gas daily, and has contracted for gas with Phillips Petroleum Company and Skelly Oil Company. This plant is located in the east half of the east half of section 127, block 5, I. & G. N. Ry. survey, on the Carson-Hutchinson County line, and on the opposite side of the Santa Fe Railroad from the Western Carbon Company original plant in the district. H. E. Norrice is in charge of this plant, with headquarters at Borger, Texas.

The Godfrey L. Cabot & Company, Inc., Boston, Massachusetts, is making good progress on the erection of a channel type of carbon black plant consisting of 125 burning houses on Skelly Oil Company's Schafer Ranch property in Northeastern Carson County. This plant will handle between 50 and 60 million cubic feet of residue gas daily from Skelly's natural gasoline plant. Magnolia Petroleum Company has a plant in the Wilcox-Pampa field, Gray County, making about 5600 pounds of black daily in 36 burning houses.

Cotton Valley Plant

Shreveport, La.—The natural gasoline plant of the Louisiana Oil Refining Company in the Cotton Valley field of northern Webster Parish has been completed and placed in operation. The capacity of the plant is stated as 10,000,000 cubic feet of gas daily, with a gasoline production around 4000 gallons daily. Part of the equipment in this plant was formerly in service at the company's refinery at Bossier City as a vapor recovery plant.

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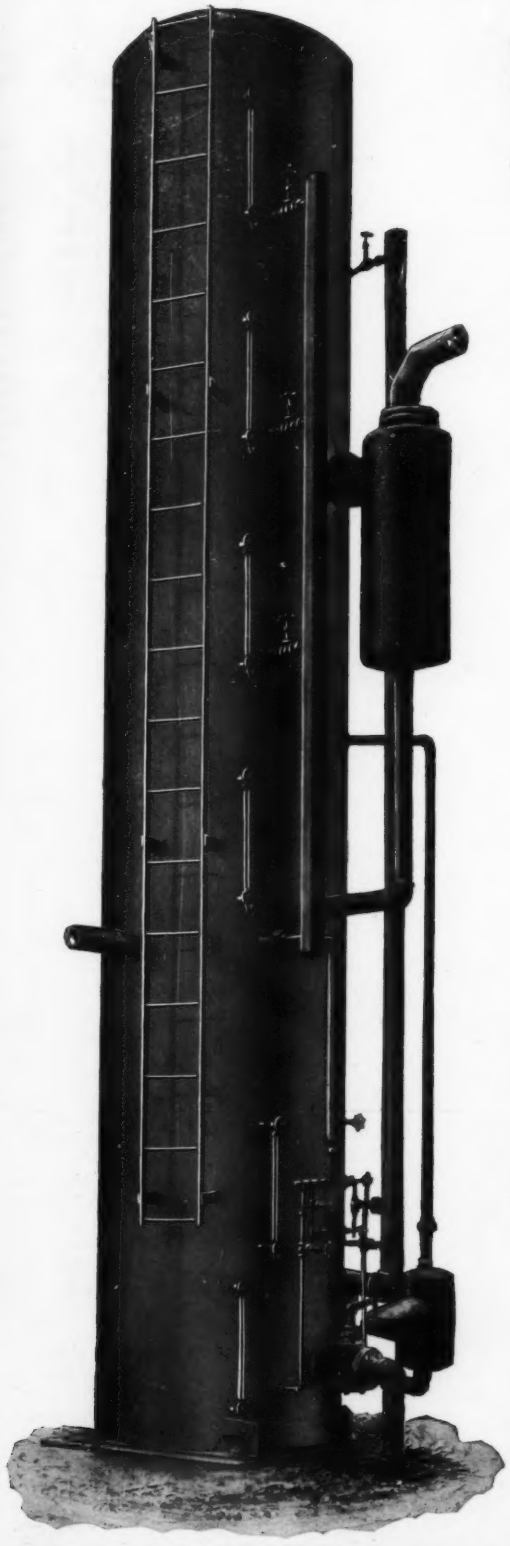

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Investigations on Cracking

A. SACHANEN and M. TILITSCHEYEW

Petroleum Zeitschrift, 1927, 521.

A Contribution from the Central Laboratories of Grosneft, Grosny.

REFINED in accordance with the narrow sense of the word, the cracking process is understood to mean the decomposition of petroleum and petroleum products at temperatures which vary between 500 and 550 degrees C, while higher temperatures, such as 650 degrees C and over, are suitable for the pyrogenetic decomposition of the oils. The formation of small amounts of gases and coke (amounting in all to between 4 and 12 per cent) is very characteristic of the cracking process. Cracked gasoline differs from the gasoline that is obtained by ordinary distillation methods in possessing a higher proportion of unsaturated hydrocarbons (from 30 to 50 per cent). The pyrogenetic decomposition results in the production of large amounts of gas and coke (amounting in total from 50 to 60 per cent). Gasoline, which is obtained by the pyrogenetic decomposition of petroleum products, contains in addition to olefines, large amounts of aromatic hydrocarbons, while naphthalene and anthracene and the like are found in the higher boiling fractions. It must be mentioned here that the higher fractions of cracked products do not contain aromatic hydrocarbons which are condensable.

The decomposition of carbon or carbon is similar in character and yields coal tar or gas tar, depending on the temperature of the decomposition. Coal tar possesses the properties of the cracked products, while the gas tar is similar to the products that are obtained in the pyrogenetic decomposition of petroleum oils. The coal tars are differentiated from the products that are obtained by the cracking and decomposition of petroleum oils only by the fact that phenols are present in the tars.

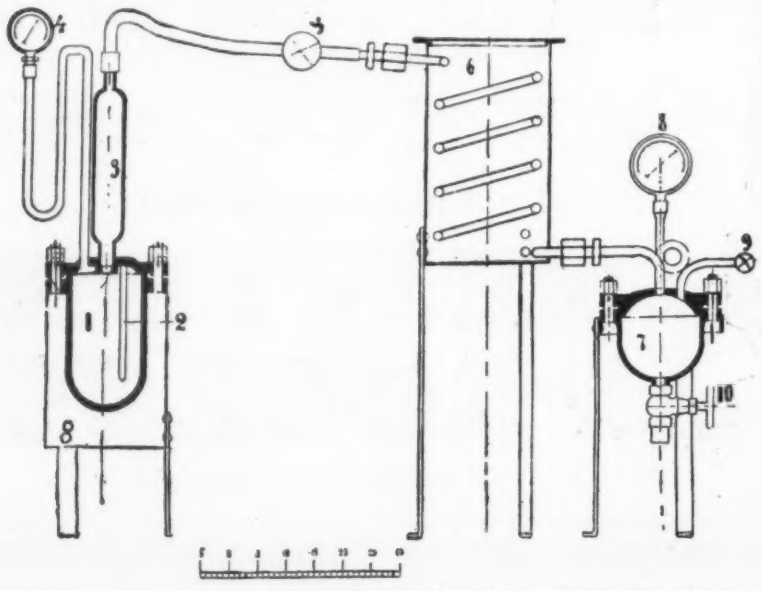
Although the cracking process has attained a position of paramount importance in the oil industry, nevertheless investigations of a systematic character on the physical conditions that control the process are still faulty. The purpose of the investigations which are reported in this article was to obtain a more accurate idea of the connection between the factors of time, pressure and temperature and the results obtained in the oil cracking process.

The cracking apparatus, which was used by the investigators, is shown in illustration, consists of the autoclave 1, which has a capacity of two and one-half liters and which is provided with the thermometer well 2 for the insertion of a suitable thermometer. The cover of the autoclave which is provided with the dephlegmator 3, is fastened hermetically tight to the autoclave by means of bolts. The cracking process is carried out in this apparatus with the valve 5 closed and is allowed to proceed for so long a time until the temperature and the pressure have attained certain definite values. Both the temperature and the pressure are regulated by heating the autoclave and by opening the valve 5. The distillates that are obtained in the cracking process are allowed to flow into the condenser 6, and thence into the collecting vessel 7, and the gases which are evolved and which are not condensed are allowed to escape through the cock 9 into the air or into a gasometer.

After the cracking process has been ended, the cracked distillates (in 7) and the residues in 1 are distilled and three fractions are obtained. These are cracked gasoline up to a boiling point of 200 degrees C, cracked kerosene from 200 to 300 degrees C and cracking residuals above a boiling point of 300 degrees C. The proportion of resins (acid resin number), asphaltenes (determined with the aid of petroleum ether) and coke are also determined by the usual methods.

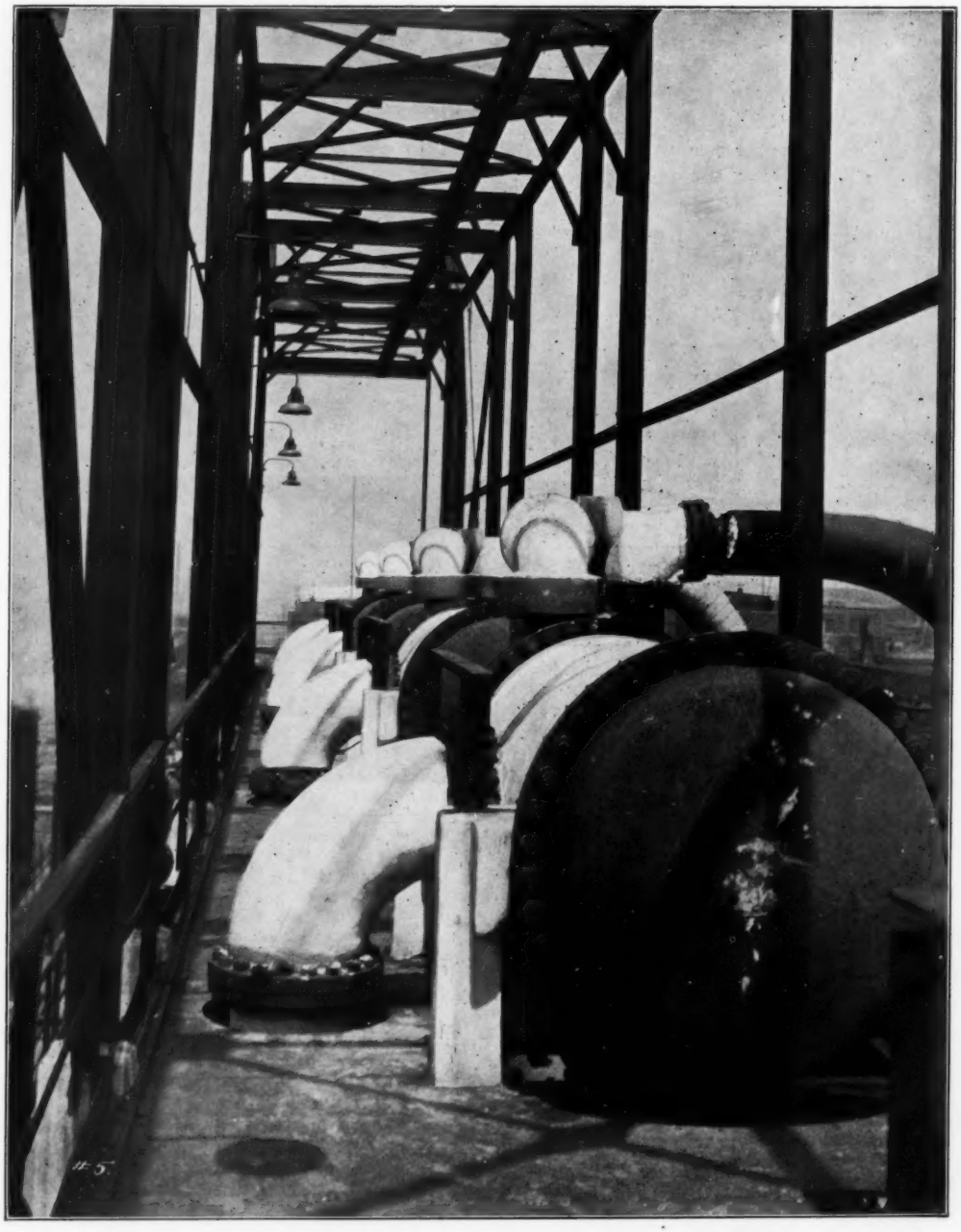
Inasmuch as the temperature of cracking, that is the one measured, is reached after a certain period of time spent in preliminary heating, and inasmuch as the cooling of the apparatus also consumes a certain amount of time, corrections must be made in the obtained results to take care of these conditions. For example, when the cracking is carried out at a temperature of 425 degrees C and tested over a period of 30 minutes, then the duration of the preliminary heating from a temperature of 375 degrees C to 425 degrees C is 15 minutes and the duration of the cooling from 425 degrees C to 375 degrees C is eight minutes.

The corrections are calculated in the following manner. Since the average temperature of the preliminary heating and cooling operations (from 375 degrees C and back again to that temperature) is 400 degrees C and as the duration of these operations amounts to 23 minutes, then in addition to the cracking at a temperature of 425 degrees C, it is also necessary to take into consideration the effects of the cracking operation which is effected at a temperature of 400 degrees C over a period of 23 minutes. As will be mentioned below, the rapidity of the cracking process at a temperature of 425 degrees is six times greater than that at a temperature of 400 degrees C. Hence the duration of the cracking process at 425 degrees C is 23:6 or approximately four minutes when figured on this basis. This duration of time corresponds to the preliminary heating and cooling and the time period of the main cracking operation is therefore increased. Hence, when these conditions are taken into consideration the correct duration of the cracking process at a temperature of 425 degrees C is the sum of 30 minutes and four minutes or 34 minutes. The duration of the preliminary heating and cooling operations down to a temperature of 375 degrees C is not taken into consideration, inasmuch as the cracking of these temperatures is so slow as to be unmeasurable.



Properties of Oil

These cracking investigations were carried out on a paraffin oil which was obtained by the distillation of a petroleum rich in paraffin. The properties of this paraffin oil are as follows. The specific



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TABULATION NO 1
Cracking of Paraffin Oil

Conditions				Yields of						Cracked Gasoline Up to 200°C			Cracked Kerosene 200-300°C.			Cracked Residue From 300°C.		
Number	Temp. in Degrees C.	Pressure in Atms.	Duration	Gasoline (up to 200°C.)	Kerosene (200-300°C.)	Residue (1) (from 300°C)	Asphaltenes	Coke	Gas and Loss	Quantity of Cracking Distillate in Gals.	Sp. Gr. at 15°C.	Acid Resin No. in %	Coefficient of Refraction	Sp. Gr. at 15°C.	Acid Resin No. in %	Coefficient of Refraction	Sp. Gr. at 15°C	E_{20}	Congelation Point in °C.	Acid Resin No. in %	Number
1	375	2	9 Hr.	4.2	13.8	78.2	0.00	0.00	4.1	26	0.749		1.4225	0.828	8	1.4638	0.888	2.25	+25	8	1
2	400	5	3 "	9.8	17.0	67.4	"	"	4.8	99	0.737		1.4182	0.829	9	1.4634	0.900	2.11	+22	20	2
3	400	5	6 "	30.1	26.4	29.1	0.70	0.33	10.8	429	0.749		1.4244	0.840	9	1.4713	0.963	4.30	+ 6.5	41	3
4	400	15	6 "	19.6	26.5	44.9	0.51	0.00	7.9	67	0.753		1.4251	0.837	8	1.4694	0.931	2.77	+10	18	4
5	400	5	9 "	40.2	15.5	13.6	0.80	1.37	23.8[2]	591	0.748		1.4244	0.840	6	1.4649	1.070	2.42	+ 2	5	5
6	400	5	9 "	30.2	27.1	19.2	0.55	2.30	18.6[2]	472	0.745		1.4251	0.835	..	1.4699	1.004	3.97	— 9	58	6
7	425	5	34 Min.	14.0	17.0	64.6	0.00	0.00	3.0	198	0.744		1.4244	0.829	..	...	0.901	2.32	+16	8	7
8	425	5	51 "	21.0	16.5	51.5	"	"	8.0	304	0.748		1.4248	0.830	10	1.4659	0.912	2.37	+14	20	8
9	425	5	63 "	28.6	23.5	38.2	0.46	"	6.8	511	0.750		1.4261	0.831	10	1.4668	0.932	2.42	+ 5	37	9
10	425	10	63 "	21.5	25.4	42.4	0.30	"	7.2	257	0.741		1.4214	0.838	10	1.4700	0.940	2.80	+12	15	10
11	425	15	63 "	20.0	24.2	45.4	0.32	"	8.7	114	0.746		1.4222	0.837	10	1.4695	0.928	2.74	+10	20	11
12	425	5	94 "	34.2	29.0	21.6	1.40	0.62	9.0	666	0.748		1.4259	0.831	12	1.4666	1.040	9.39	—10	74	12
13	425	5	5 Hr.	38.0	25.0	8.1	0.29	8.59	14.4	692	0.750	14.5	1.4253	0.830	10	1.4673	..	..	..	18	13
14	425	10	62 Min.	17.5	22.7	48.7	0.23	0.00	7.2	172	0.740		1.4199	0.832	9	1.4670	0.921	2.57	+18	20	14
15	450	12	8 "	18.0	23.0	52.5	0.10	0.07	4.9	289	0.741		1.4216	0.832	12	1.4671	0.911	2.35	+15	8	15
16	450	10	9 "	26.1	27.2	37.3	0.09	0.32	6.8	472	0.746	13.0	1.4244	0.834	10	1.4679	0.942	2.63	0	27	16
17	450	5	13 "	26.0	32.0	32.1	0.46	0.71	6.0	754	0.740		1.4219	0.830	10	1.4663	0.934	7.07	— 4	29	17
18	450	10	12 "	30.0	31.0	29.2	0.89	0.27	6.1	643	0.742	13.0	1.4237	0.833	10	1.4677	0.951	3.68	— 2	72	18
19	450	15	13 "	28.9	21.3	37.4	0.38	0.11	8.7	374	0.743		1.4223	0.838	8	1.4698	0.944	3.17	+10	28	19
20	450	10	20 "	34.0	30.0	18.9	2.38	1.40	10.6	678	0.746		1.4247	0.834	9	1.4688	0.983	2.50	— 6	69	20
21	450	10	36 "	37.5	29.7	14.1	1.99	3.47	11.3	694	0.749	13.0	1.4249	0.835	10	1.4709	1.029	3.35[3]	— 4[3]	77	21
22	450	5	66 "	29.0	34.0	19.2	1.13	3.73	11.2	762	0.743	11.0	1.4249	0.831	8	1.4672	0.875	1.25	+ 1	16	22[3]
23	475	15	4 "	27.7	30.3	22.6	1.33	1.43	10.5	643	0.746		1.4230	0.833	10	1.4683	0.951	2.16	—18	96	23
24	475	15	34 "	38.8	26.6	8.2	0.35	9.05	13.4	720	0.751	12.0	1.4268	0.837	8	1.4776	0.984	..	+ 3	17	24

[1]The yield of cracked residue is given in this tabulation, not including the asphaltenes and carboides.
[2]The greater losses here are explained that the apparatus was not quite hermetically sealed
[3]The residue is free from coke.

weight at 15 degrees C was 0.883, the Engler viscosity at a temperature of 50 degrees C was 1.96, the acid resin number was 5 per cent, the congealation point was plus 31 degrees C, the content of paraffin in the oil was 10.5 per cent, the boiling temperature was 180 degrees C at the beginning, the fraction boiling up to 200 degrees C was 0.3 per cent and up to a temperature of 300 degrees C 3.3 per cent. A distillation of the oil under a vacuum of four millimeters gave the following results:

	Per cent	Specific gravity at 15 deg. C
74 to 190 degrees C		
190 to 220 degrees C	21.6	0.873
220 to 250 degrees C	26.8	0.891
250 to 280 degrees C	21.2	0.897
280 to 310 degrees C	8.8	0.906
Residue and losses	6.1	....

The results of the cracking of the paraffin oil are given in tabulation I.

As may be seen from these tabulated results, the lower boiling and higher boiling products of decomposition—gasoline and kerosene—are formed in almost equal proportions. When the temperature and pressure conditions are maintained constant, the yield of cracked gasoline or the total yield of gasoline and kerosene rises as the duration of the process increases up to a certain limit. (See experiments 7, 8, 9, 12, 13 or 15, 18, 20 and 21 in the accompanying tabulation Number I.) It is of importance to determine that these total yields are independent of the temperature. The total yield of cracked gasoline from the paraffin oil that is being tested, is 38 to 39 per cent and the total limiting yield of gasoline and kerosene is approximately 65 per cent. Figures 2 and 3 clearly show in graphical form the aforementioned important conclusions.

It is possible to obtain a yield which is higher than 38 to 39 per cent by repeated cracking in accordance with the methods that are used in the various modern cracking plants.

Specific Gravity at 15 degrees C.	0.742	0.746
Beginning of boiling	56 degrees C.	52 degrees C.
Up to 100 degrees C.	21 per cent	22 per cent.
Up to 160 degrees C.	70 per cent.	22 per cent.
Up to 200 degrees C.	89 per cent	92 per cent

Influence of Pressure

The influence of the pressure on the cracking process is not of the maximum importance. An examination of tests 9, 10, 11 or 17, 18 and 19 shows that the pressure has the effect of reducing the yields of cracked gasoline and kerosene. This phenomenon stands in close relationship with the maintenance of the cracked distillates at high temperature which exists in the condensation process. These condensation processes can be avoided in the cracking tubes system, which is used at the present time, and in which the oil is maintained under high temperature conditions for a very short time only. The role of the pressure in the cracking processes consists only in that the pressure makes possible the existence of the liquid state, which is the principal condition that must be fulfilled in the common form of present day cracking processes. (Compare, for example, B. Cross, A Handbook of Petroleum, 1924, pages 289 and 314.)

The time which is required for obtaining the limiting yield of cracked products, 65 per cent, depends very essentially on the temperature of the process. The following results were obtained as shown in the tabulation:

TABULATION NO. II.
Cracking of Different Petroleum Products

		Conditions.			Yields.					(2)
No.	Petroleum Products	Temp.	Pressure in ats.	Duration in min.	Gasoline up to 200°C.	Kerosene 200 to 300°C.	Asphaltenes	Coke	Gas and Loss	Residue at 300°C.
25	Paraffin	450	10	12	31.2	24.7	0.00	0.00	8.3	31.2
26	Paraffin	450	10	16	40.0	29.2	0.00	0.00	8.3	19.2
27	Paraffin	450	10	32	43.3	34.9	0.04	0.04	8.2	8.2
28	Paraffin	450	10	31	35.7	27.1	0.08	0.11	26.8	6.2
32	Kerosene	450	15	12	4.9	83.5	0.00	0.00	4.8	4.8
33	Kerosene	425	15	63	8.7	79.8	0.00	0.00	8.1	2.9
34	Solar oil	450	10	12	18.6	43.6	0.19	0.15	6.3	29.5
35	Bearing oil	450	10	12	28.2	30.5	0.45	0.66	6.3	30.6
36	Machine oil sp. gr. 0.904	450	10	12	31.2	24.1	1.10	0.89	8.6	30.0
37	Machine oil sp. gr. 0.930	450	10	12	29.5	23.5	3.21	6.04	10.6	23.3
38	Machine oil sp. gr. 0.930	440	10	12	25.7	23.5	1.10	0.17	7.7	39.4
39	Machine oil sp. gr. 0.931	450	10	11	30.4	20.5	8.04	8.04	18.5	19.4

	Cracked Gasoline Up to 200°C.		Cracked Kerosene 200 to 330°C.			Cracking Residue at 300°C.		
No.	S.p Gr. 15°C.	Index of Refraction	Sp. Gr. 15°C.	Acid Resin No.	Index of Refraction	Sp. Gr. 15°C.	E_{20}	Congelation Point	Number
25	0.720	1.4116	0.782	9	1.4402	0.830	1.80	+35.0	16
26	0.724	1.4142	0.785	8	1.4422	0.835	1.60	+29.5	8
27	0.729	1.4154	0.783	8	1.4420	0.830	1.25	+24.6	6
28	0.745	1.4239	0.826	13.5	1.4628	0.930	1.95	— 6.0	21
32	0.740	1.4203	0.818	5	1.4586	0.848	1.19	+ 0.5	4
33	....	1.4230	....	4	1.4596	0.1824	1.30	....	15
34	0.746	1.4250	0.862	12	1.4839	0.915	1.80	—19.0	10
35	0.753	1.4282	0.862	14	1.4825	0.997	3.92	—19.0	23
36	0.760	1.4312	0.862	14	1.4832	1.019	5.50	—10.0	46
37	0.754	1.4289	0.850	14	1.4771	0.917	1.30	—16.5	7
38	0.753	1.4267	0.854	10	1.4782	1.014	18.60	— 2.0	60
39	0.756	1.4299	0.854	15	1.4797	0.935	1.63	—19.5	10

(1) The paraffin oil was purified with the aid of fuming sulphuric acid.
(2) The figures in this column represent the yield of cracked residues without the asphaltenes and the carboides.

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Temperature of cracking	Duration of the limiting yield of cracked products
375	45 hours
400	9 hours
425	1½ hours
450	12 minutes
475	2 minutes, calculated
500	20 seconds

As is shown by these figures, the speed of cracking is increased by about five to six times in every 25 degrees rise of temperature. This is similar to other chemical reactions, that is approximately twice speed for each 10 degrees rise in temperature (Centigrade.)

Condensation products are also formed in addition to the decomposition products, cracked gasoline and cracked kerosene. As can be seen from the data which has been given above, the residues that are obtained in the cracking process possess a higher acid resin number and a very high specific gravity, up to 1.04, and this seems to indicate, or at any rate it agrees, with the supposition that considerable condensation has taken place during the process. It should be mentioned at this point that higher fractions of the paraffin oil possess a specific gravity of only 0.897 up to a maximum of 0.906. It follows from experiments 2, 3, 5, or 7, 8, 9 12, or 15, 18, 20 and 21 that the specific weight of the cracked residue increases with the progressive duration of the cracking process. A prolonged duration of the cracking process causes the formation of asphaltenes and carbides (coke), which may likewise be considered as condensation products.

Other Oils

The reciprocal ratios of the condensed oils, asphaltenes and carbides are explained, for example, by comparing the results obtained in experiments 7, 8, 9, 12, 13, or 15, 16, 20, 21. As the duration of the cracking process progresses, the acid resin number of the residue decreases, whereby the content of asphaltenes and carbides increases to a marked degree. The asphaltenes finally likewise disappear and only the very stable carbides (coke) remain behind.

The rapidity of the cracking process does therefore not only depend on the temperature and the duration of the process, but also on the properties of the petroleum products. The authors have investigated the cracking of a bearing oil distillate which had a specific gravity of 0.904, of a machine oil distillate, which had a specific gravity of 0.916 and of a cylinder oil distillate, specific gravity of 0.930. The tests were carried out at a temperature of 450 degrees C and under a pressure of 10 atmospheres. The kinetics of this cracking process is the same as that of the cracking of paraffin oil under similar conditions. The yield of cracked gasoline amounted to between 28 and 31 per cent, and that of kerosene to about 25 per cent. The formation of the asphaltenes and carbides increase as the specific gravity of the oil similarly increases. The results of these experiments are given in tabulation No. II.

In contradistinction thereto the cracking of a solar oil of 0.883 specific gravity, takes place about one and one-half times to twice as slow in comparison with the cracking of the paraffin oil, as described above. Kerosene, possessing a specific gravity of 0.821, decomposes under these conditions, that is 12 minutes cracking at a temperature of 450 degrees C and a pressure of 15 atmospheres, at a much slower rate and yields only 4.9 per cent of gasoline. When a light solar oil and kerosene were cracked, the authors were not able to detect the formation of any asphaltenes or carbides.

The results which have been mentioned above lead to the conclusion that light decomposition products such as gasoline and kerosene, and heavy condensation products are formed during the cracking process from the various ingredients of the mineral oil. In order to explain this phenomenon the cracking of paraffin was investigated more in detail. The paraffin had a melting point of between 52 and 54 degrees C. The cracking of paraffin oil, which had been purified with the aid of 80 per cent of fuming sulphuric acid, was also investigated. This paraffin oil had a specific gravity of 0.852, a viscosity of E_{20} of 1.96 and a congelation point of 32.5 degrees C. The results of this cracking process are given in tabulation number II.

No Coke Formed

As can be seen from experiments numbers 25 to 27, the cracking of the paraffin does not result in the formation of any coke. The specific weight of the cracked residues remains unchanged and is independent of the duration of the cracking. It can, therefore, be determined that the cracking of paraffin hydrocarbons produces no condensation phenomenon. When purified paraffin oil is cracked, the condensation phenomena are likewise very weakly defined. Inasmuch as fuming sulphuric acid principally removes the aromatic hydrocarbons, it may be concluded therefrom that the condensation phenomena and the formation of coke (as the last stage in these phenomena) take place principally at the expense of these aromatic hydrocarbons. This conclusion agrees very well with other data on this subject. Such heavy petroleum oils with a high content of aromatic hydrocarbons give rise to the formation of considerable quantities of coke during the cracking process.

The chemical composition of the cracked gasoline was determined in accordance with the methods developed by G. Egloff (see Industrial and Engineering Chemistry, volume 18, pages 354ff, year 1926). These methods give approximate results for the content of methane hydrocarbons, naphthenes, olefines and aromatic hydrocarbons in the gasoline.

Gasoline Composition

These analyses show strong influence of the pressure on the content of olefines in the cracked gasoline, which corroborates the findings that were made by other investigators in this field. The composition of the cracked gasoline is given in tabulation number III, the gasoline in this case being obtained by the cracking of paraffin oil.

Increasing the pressure has the effect of diminishing the content of olefines in the cracked gasoline.

The content of naphthenes in the cracked gasoline that was examined by the authors is quite small, being only 4 to 7 per cent. It should be remarked at this point that the cracking of petroleum oils, which contain considerable amounts of paraffin, yields a cracked gasoline which contains the smallest proportion of naphthenes.

Naphthenes Absent

The cracked gasoline that was obtained from paraffin showed a most complete absence of naphthenes (the critical solution temperature in aniline after treatment with fuming sulphuric acid is 70.8 degrees). These investigations have led to the conclusion that in contradistinction to the opinions of various investigators (Compare, for example, B. Leslie, Motor Fuels, pages 295ff, 1923). The closing ring of the olefines and the conversion into naphthenes plays no important role in the cracking process and in determining its governing conditions.

It is interesting to compare the chemical composition of the cracked gasoline with that of gasoline obtained in the ordinary distillation process, the petroleum in this case coming from the Grosny district. The results of this comparison are given in the following tabulation, Number IV.

As can be seen from the above tabulation, cracked gasoline differs from the ordinary gasoline in three ways. In the first place cracked gasoline contains olefines which are not present in ordinary gasoline; in the second place, the cracked gasoline contains a higher proportion of aromatic hydrocarbons, and in the third place, it contains a lower proportion of naphthenes.

In conclusion the authors are giving below a tabulation which shows the results obtained, according to Engler, in distilling the cracked gasoline which is obtained from the processing of paraffin oil.

TABULATION NO. III.

	Cracking Conditions.			Composition of the Gasoline.			
		Duration		Methanes	Naphthenes	Aromatics	Olefines
No.	Temp. °C.	Hrs. Mins.	Pressure in atms.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
3	400	6	5	60.7	7.5	16.3	15.5
4	400	6	15	..	..	14.5	9.0
9	425	1—2	5	49.6	4.5	19.6	25.5
10	425	1—2	10	..	..	..	17.0
11	425	1—2	15	..	..	14.3	7.0

TABULATION NO. IV.

Gasoline from	Methanes Per Cent.	Content in Naphthenes Per Cent.	Aromatics Per Cent.	Olefines Per Cent
Paraffin rich petroleums (1)	71.3	21.7	7.0	....
Petroleum free from paraffin	58.6	33.9	7.5	....

(1) See A. Sachanen on petroleums from the Grosney district, Petroleum Zeitschrift, year 1926, pages 1240ff.

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Oklahoma University Has 300 Barrel Refinery

Norman, Okla.—Petroleum engineering students of the University of Oklahoma will be privileged to study refining methods first hand following completion of a 300-barrel plant to be assembled at the school. The small refinery is being constructed from units donated by various manufacturers in the East, and crude run in the plant will be the donation of producers in Oklahoma.

Professor F. W. Padgett of the petroleum engineering school announced final plans for the erection of the plant late in September, and stated that although plans for the refinery have been in the making for about two years, final arrangements have now been completed. Oklahoma University is the first in the United States to obtain such a refinery for class and research work, according to Professor Padgett, donors of material saying that Oklahoma is the logical place for its installation because of its centralized position in the producing and refining section of the country.

The refinery is planned to be complete in every detail soon with the exception of a wax plant, which is to be added later. The plant will be capable of producing gasoline, naphtha, kerosene, lubricating oil, asphaltum, road oil and cylinder oils. The purpose of the refinery is for research work only, and none of the products will be placed on the market, according to Professor Padgett.

For the past five years the school of petroleum engineering at Oklahoma University has had the use of a one-barrel refinery, which was constructed by Professor Pagett, and while theories could be illustrated, and some actual practice obtained, the plant was too small to illustrate many modern and typical methods employed by refineries.

One of the outstanding values of the school plant, as explained by Professor Padgett, will be to producers of Mid-Continent crude. With such a research laboratory the corps of professors in the petroleum school will be able to investigate the reaction of various grades of crude produced in Oklahoma to certain processes of refining, with the result that the school will extend its already large scope of work into that of advisor and research seeker for methods which will be of assistance to the producers.

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Sweetwater, Texas. — J. H. Travis, J. R. Travis, and A. R. Stribling have taken over and started operating the small skimming plant of the Sweetwater Refining Company here. The new owners have been identified with the petroleum refining business in the Mid-Continent fields for many years. The company is charging but 300 barrels to the plant daily, planning later to improve and increase the capacity of the installation.

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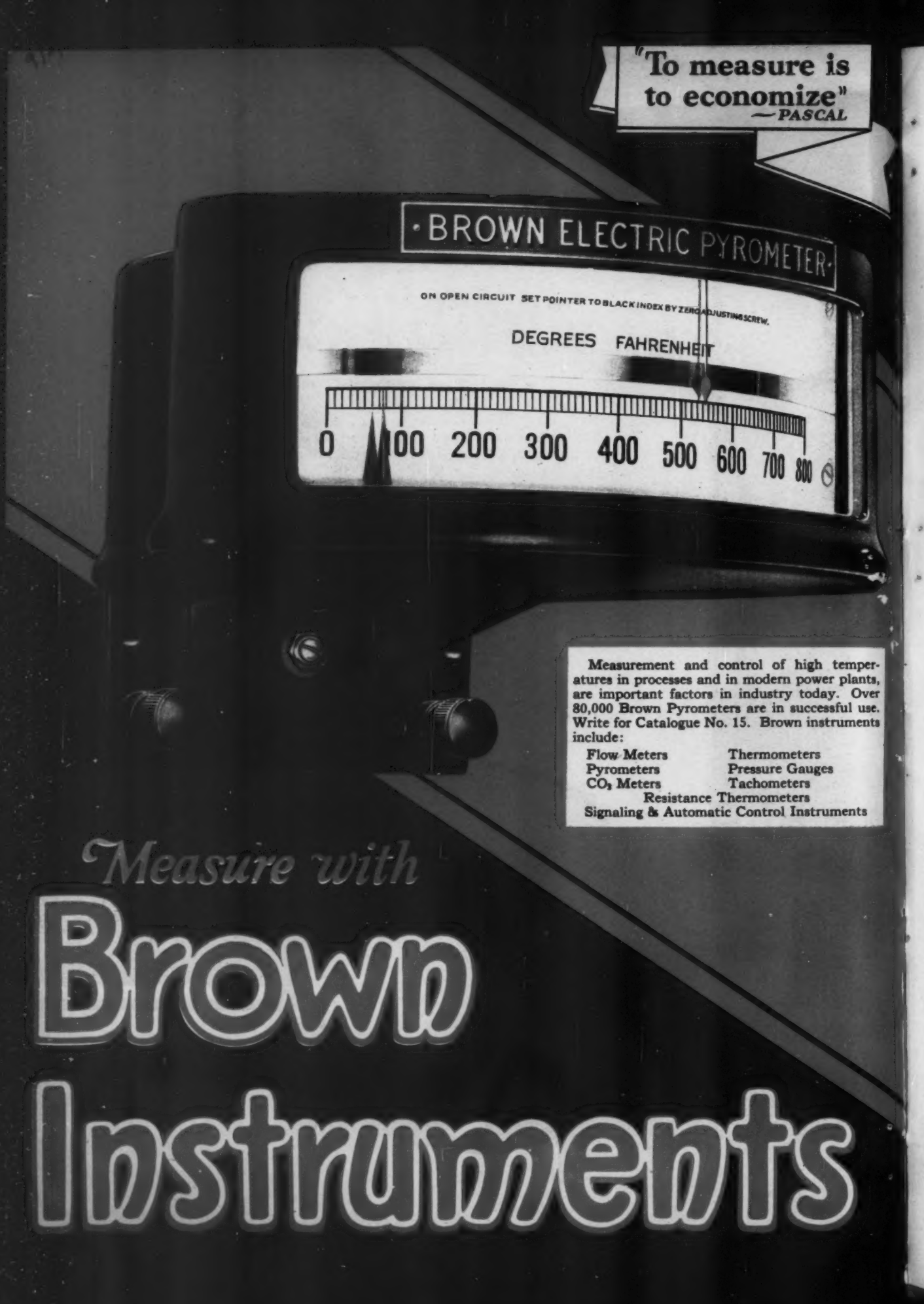

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Distillation of Gasoline Under Pressure

By ISMAR GINSBERG

THE international aspect of oil is rendered evident in more than one fashion. We know well the political significance of petroleum and realize that the distribution of oil is wide. Russia and other Slavic countries are important oil producers, and it is natural that in such countries some attention should be given to the technical problems of oil mining, oil transportation and oil refining. From a certain standpoint it is of course true that these countries are not as highly developed in the technical field as we are, but there sometimes are carried out investigations and experiments which yield information that can be of value even to those who are much further advanced in oil technology. We refer to the work that is occasionally done by Polish oil chemists and engineers and in as much as Polish is a language that is read by but few Americans and Europeans, for that matter as well, these investigations do not receive the publicity that is due them. We have such a case right at this moment, a series of investigations having been conducted by a Polish chemist, J. Pfanhauser, and published in the Polish chemical journal, but probably never before brought to the attention of American oil men in a language that they can read. We are therefore glad to give a resume of this work, which is on the distillation of gasoline under pressure, translated into the English through the German, published in Petroleum Zeitschrift, 1927, pages 551ff.

The problem was to distill gasoline under pressure in such a manner so as to avoid losses by vaporization. The construction of the apparatus is seen from the accompanying illustration. The apparatus consists of two columns or towers G and H, connected by a pipe, controlled by means of a valve W^3. The tower G is surrounded with insulated wire throughout its length, one meter, and is filled internally with quartz pebbles, each being five millimeters in diameter on the average. This tower serves both as a dephlegmating column and an electric "oven." The tower or column H represents the cooling apparatus and is made with double walls, cooling water inlet at the bottom and outlet at the top. The cooling water can flow through the Fletscher "furnace" F, which renders possible the heating of the water to the same temperature as the temperature of the water line water. Both towers are provided with manometers, M_1 and M_2, as well as with the thermometers T_1 (located in an asbestos pocket in the interior of the "oven") and T_2 (which is soldered into a metallic well, which reaches for a distance of five centimeters into the interior of the "oven" and indicates the temperature of the evolved vapors), and finally T_3 (which shows the temperature of the cooling water).

Operating Process

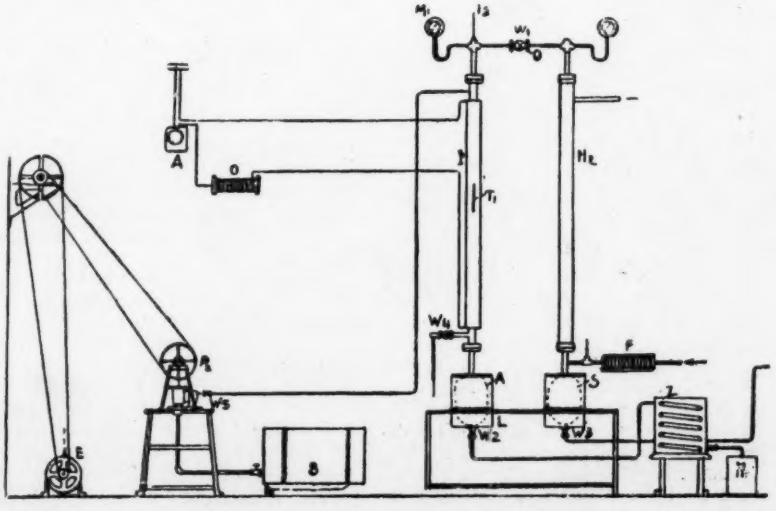
The gasoline is pumped out of the container B by the pump P, the motor E and the pipe C. The gasoline is pumped through the valve W_5 into the upper portion of the "oven," where it flows in until the apparatus is full or until the level of the gasoline reaches a certain height in it. Then the gasoline is evaporated and subjected to dephlegmation, whereat the vapors pass over through the valve W^1 into the cooler and from that point through the valve W^2 into the vessel K, the remainder flowing into the enlarged vessel R, which is arranged in an oil bath, and from that point through the valve W_2 through the cooler Z into the receiver N. The "oven" is operated by means of an alternating current of 110 volts, which is regulated by means of the coil O and the voltage of the current can be read off a suitable voltmeter A. The apparatus is constructed of iron, and the tower or column is made from piping which is soldered together under a pressure of thirty atmospheres and the height of the apparatus is two and one half meters.

The experiments that were carried out with the apparatus are divided into two parts. First experiments were made in accordance with the continuous method and second in accordance with the static method.

We are first concerned with the fractionation of gasoline under increased pressure in accordance with the continuous method. The tests were made with heavy gasoline and the method used was as follows:

The vessel in which the gasoline was placed was provided with a float and the gasoline was removed from the vessel by the pump. The valve W_1 is closed and water is allowed to flow through the cooler. Thereafter vapors are led into the "oven." The maximum pressure after the removal of the vaporizer was nine atmospheres in the first minute and then it fell to six atmospheres. After the attainment of the corresponding temperature T_1 in the "oven," the pump is started operating. The gasoline is allowed to flow in and is subjected to fractionation. The residue begins to flow through the valve M_2 and the distillate through the valve W_1 into the cooler and the receiver, at the moment that the corresponding pressure M_1 is reached.

Inasmuch as the use of an oil bath at R was not considered essential, this portion of the apparatus is shunted off by some suitable closure. The residue is then removed through the valve W_4. The specific gravity of the product that is obtained in this manner is tested with the aid of a pycknometer of the type designed by Prof. Kling. The



heavier fractions were tested with the aid of the Spren gel pycknometer or with the aid of the Mohr balance. The Mohr balance also can be used after cooling with ice for the more rapid determination of the specific weight of lighter fractions.

Values

The empirical method can also be used in determinations above plus 15 degrees C, which is specially suited for gasoline with specific gravities of 0.63 to 0.65. The formula is:

$d_{15} = d_t + K(15-t)$, with K equal to 0.00082.

The value for K is determined for gasoline of various specific gravities at various temperatures for the Mohr balance. The following tabulation gives some of these values.

Fraction 0.6562 + 15 degrees C.					
t° C	d	K-10—4	t° C	d	K 10—4
—5.5	0.6730	...	5.8	0.6623	10
—4.3	0.6721	9	7.2	0.6612	11
—3.9	0.6719	2	8.4	0.6602	11
—1	0.6699	2.5	9.4	0.6590	9
0	0.6684	5	11.0	0.6580	13
+0.8	0.6675	5	12.3	0.6575	10
+1.2	0.6660	9	13.0	0.6565	5
+3.	0.6655	15	14.7	0.6559	10
+3.3	0.6644	5	15.5	0.6556	6
+4.5	0.6634	11	16.1	0.6555	4

The average value of K is 0.00081. For the fraction (specific gravity 0.6348 plus 12 degrees), K is equal to 0.00083 and for the specific gravity 0.652 plus 3,K, is 0.00094.

The results that were obtained in the distillation of gasoline in accordance with the continuors method are given in the following tabulation.

Static Method

The second set of experiments were carried out in accordance with the static method under pressure. The results that have been given above are of particular importance to the oil technologist, for it shows him that it is possible to obtain light gasolines under pressure in a closed apparatus, by a continuous process, without any special cooling arrangements and without any losses. However, from the practical standpoint this excellent resu't, nevertheless would appear to be doubtful, for the reason that in the normal distil'ation process, which specifies no maximum and no minimum limits for the vapors the separation under increased pressure must be more difficult, while in the given case lighter fractions were obtained.

TABLE I

Distillation Test According to the Continuous Method

Run	Specific Grav. of gasoline	Liters per hour	Wt. of fraction	Pressure Oven P' absolute	Pressure Cooler P" atm.	Current density	Temperatures t' of oven	Temperatures t" cooler inlet	Temperatures t"' of cooler	t"" of oil bath
1	0.6710	3	0.6423	1	1	4.5	75	..	9	95
2	0.6710	2.9	0.6028	4	1	4.5	73	..	9	85-110
3	0.6710	3	0.5996	6	1.5	5.5	100	..	9	110-125
3a	0.6727	10	0.6510	4	..	..	90	..	9	....
4b	0.6727	3	0.6368	4	..	..	90	..	9	100-120
4c	0.6727	1.3	0.6135	4	..	..	90	..	9	....
5	0.6350	..	0.6080	13	1.5-2	6	120	60	40	....
6	0.6350	..	0.5742	13.5	2-3	6-7	120	57	37	....
7	0.6350	..	0.5611	13	3.5-4-5	6-7	117	56	37	....

Samples 1 to 4 represent heavy gasolines, and 5 to 6 light gasolines. P' is the pressure indicated by the furnace of oven manometer, P" the pressure indicated by the cooler of condenser manometer, t' the temperature of the furnace or oven, t" the temperature at the inlet to the condenser, t"' the temperature in the condenser and t"" the temperature of the oil bath. All figures have been calculated on the basis of +15 degrees C and the figures for t' and t" are approximate.

The general conclusion that can be drawn from these results is first that in accordance with the increase in the pressure in the "oven" the specific weight of the fraction undergoes a decrease. (See examples 1, 2 and 3). The production of light fractions is dependent on the rapidity of the addition of gasoline to the distilling apparatus. The freer the flow of gasoline, the lower the specific gravity of the fraction. (See Example 4). The pressure in the condenser of cooler has an effect on the specific gravity of the fractions. The specific gravity of the fraction is lower, the higher the pressure.

In order to determine just how the process does work, the apparatus was tested out with the aid of a mixture of alcohol and ether. In order to simplify the process still further, the distillation was carried out in accordance with the static method, whereby the mixture was heated under pressure practically in the dephlegmating column and led away to a special cond of the distillate at the top of the column and led away to as pecial condenser, that the condition of the mixture was not changed in any way. To this end the column G was disconnected from the pressure condenser H and connected with a small cooler with the aid of the vessel D behind the valve W_1, and also with an iron shell for sample taking.

The results obtained on the distillation of the alcohol-ether mixture under different pressure corroborate the assumption that the fractionation is less accurate under the higher pressures. When very high pressures were used, it was found that the composition of the vapors was very similar to that of the liquid mixture. It was thus thought advisable to repeat the gasoline distillation in accordance with the aforementioned static method.

Source of Error

Inasmuch as it has been established above that the characteristic error involved in the relationship between the specific gravity and the pressure is due to the tendency to produce higher boiling fractions from the lighter boiling fractions, hence two kinds of gasoline were used in making the static tests. One of these gasolines was tested with heating of the lighter variety by means of ordinary distillation up to a temperature of plus 45 degrees Centigrade, and the other was obtained from the common commercial gasoline.

It should be expected that the gasoline, which has been freed from lighter constituents, should behave in a normal manner, that is, just like the mixture of alcohol and ether, and that as the pressure rises the distillation will give less and less of a separation of the ingredients of the gasoline. On the other hand the commercial gasoline, which is very rich in light boiling ingredients, yielded constantly lighter fractions under higher pressures at the temperature of the condenser.

The results that were obtained in this series of experiments showed that in the first place when in the distillation of gasoline mixtures are processed under pressure, whose ingredients possess definite dewpoints, which lie at a higher point than the temperature of the condenser, then such mixtures will behave in a normal manner. This simply means that heavier fractions are obtained as fractionation proceeds.

In the second case when the gasoline distillation is carried out with mixtures, whose ingredients possess dewpoints, which lie below the temperature of the condenser, then these mixtures behave under pressure so that lighter fractions are constantly obtained in the distillation and the separation between the variously boiling ingredients is more accurate than in the first case. This method of distillation can be used to good advantage on commercial gasolines.

In summing up it may be concluded that these experiments have shown the admissibility and usability of a column or tower installation for the technical redistillation of commerical gasoline under pressure in order to remove the lightest ingredients without the use of compressors and with the aid of ordinary cooling water. It has also been shown that the method is suitable for certain kinds of gasoline in preference to others.

Treatment of Light Oil Products

(Continued from page 52.)

age of the clay. Thus typical yields are as follows:

½ Burn Clay.....5000 bbls. per ton
14 " " .....3000 bbls. per ton
40 " " .....1800 bbls. per ton

These figures are based on sweet crudes such as Tonkawa, Burbank, etc. The clay is used until the color of the stream is 27, when the clay is steamed, dumped and burned in a wedge furnace.

The gasoline from the Gray tower carries appreciable quantity of sulphur dioxide and we have just found it necessary to remove this at once if a stable product is to be made. We, therefore inject a solution of soda ash into the gasoline condensers, and by the time the gasoline reaches the run tanks the sulphur dioxide is completely removed.

The Cross gasoline is sweetened by the plumbite as described above and results in a 30 color gasoline stable to sunlight giving 25 color after four hours exposure.

Hyprochlorite Method of Treatment

The hyprochlorite method has been used to some extent for sweetening straight run gasolines, and is handled in continuous systems.

The general procedure starts with washing the gasoline in towers, coils or baffles with strong caustic solution (about 18 to 20 degrees Be.) This removes all the hydrogen sulphide and some of the mercaptans. The water washing of the gasoline to remove the caustic solution is in the next tower. At this time the hyprochlorite is forced into the system and mixed with the gasoline by means of coils, baffles, etc. After the mixing with hyprochlorite, it is allowed to settle out, completely as possible before the final water wash is given.

Either sodium or calcium hyprochlorite may be used, the sodium can be handled with less trouble. The strength is usually about 5 to 8 grams of available chlorine per gallon of solution, and the excess caustic is about 3 to 5 grams per gallon of solution.

The action of hyprochlorite is primarily one of oxidation, but some chlorinating may take place. However, the greatest drawback to this method is the fact that it oxidizes other compounds as well as mercaptans, the products of which are often detrimental because they cannot easily be removed from the gasoline. It is for this reason that many grades of gasoline from sour crudes as Amarillo, cracked products, etc., cannot be sweetened without upsetting the equilibrium of other compounds present that cause instability to odor and color.

There is another drawback with hyprochlorite sweetening of sour crudes. The hyprochlorite does not seem to have any appreciable effect upon free sulphur so that if the crude or gasoline after distillation carried elementary sulphur, the sweetened product will not pass strip test.

The Copper-Oxide Method of Sweetening

There is obviously a great advantage to be able to sweeten in the vapor phase in connection with the Gray Process.

The use of copper oxide for vapor phase sweetening is being given considerable experimental work-out at this time. The copper oxide has been found to sweeten all crudes tried, even the Canadian and Amarillo. The yield obtained and the efficiency of the process is directly proportional to the porosity of the CuO and the surface exposed. The sweetening reactions that take place are given by Woods and cooperators.

$$\underset{\text{Copper Oxide}}{CuO} \times 2\ \underset{\text{Mercaptan}}{RSH} \longrightarrow \underset{\text{Copper Disulphide}}{(RS)_2\ Cu} + \underset{\text{and water}}{H_2O}$$

$$\underset{\text{Copper Disulphide and Heat}}{(RS)_2\ Cu} \times \text{Heat} \longrightarrow \underset{\text{Alkyl Sulphide and Copper Sulphide}}{RSR} \times CuS$$

Copper oxide has no effect upon monosulphides, disulphides, thiophenes or sulphur.

There are various processes that have been tried out in the laboratories and on commercial scale although the plumbite appears to be the most practicable and economical for the sweetening of gasoline.

Cleanest Plant Is Claim For Titusville Refinery

(Continued from page 55.)

cause the entire plant is already clean they are not often in use. Clean, dry rags and waste are provided. And the men co-operate.

It is Mr. McGraw's belief that clean surroundings, spotless machinery and equipment well cared for, is conducive to the proper manufacture of the plant's products. Each man, while on shift, is "the boss of his business and looks after the efficiency of his particular department to the exclusion of all others, and he sees to it that his tools, his buildings, floors and equipment are kept just as clean and spotless as those same materials which are under the jurisdiction of his fellow employees in the other departments. A sort of friendly rivalry exists and a desire to please and produce excellent goods is instilled into the heart of each employee. He is admonished to take care of himself, prevent accidents, prevent fires, and to keep his part of the plant turning out as near perfect products as possible. His rate of pay for his services and his co-operation is a little higher than the schedule existing in the same refining district.

One Man Per Thousand Barrels

Labor turnover is extremely low. Many of the men have been with the plant since its inception seven years ago. The plant manufactures gasoline, naphtha, kerosene, white wax, non-viscous neutrals, various grades of lubricating oils, including steam refined cylinder stock. These many and various products require numbers of handlings in their processing and much equipment. The complete lubricating oil plant with its chillers, refrigerating plants, wax plants, sweaters, filters, and earth burners is one which can require a great deal of labor if not given adequate consideration. For the manufacture of these products and the operation of the skimming plant with its treating department and loading rack, the company executives state that they base their labor requirements at the rate of "one man per thousand barrels per month." That is to say that running through 25,000 barrels per month the plant should require 25 men for the operation of all its departments, including the office men and laboratory. New men are seldom required, except as laborers. The processing departments are adequately supplied with men, in that nearly all of the process men are capable of handling any one of several positions. For example there are six qualified stillmen on the plant, where only three are needed. Filter house and wax press men have also been trained—as have additional treaters. In fact, it may be stated, virtually all of the process operators are more or less interchangeable, so that in the event of sickness, accidents or vacations, the work will proceed without breaking in new labor. The above statement of "one man per 1000 barrels per month" is not at all inelastic with this type of process men employed. The crude charged to stills may be much larger than the estimate, as is the case with nearly all refineries, without the addition of many more men. Labor overhead is usually fairly constant within certain limits.

It is generally agreed upon that men working in clean surroundings, well lighted and ventilated, will care better for their work, and the products they produce with clean, well cared for equipment, are usually of better grade than those produced under the opposite conditions. President McGraw states he "hasn't got a man who will spit on the floor." He hasn't.

Tulsa.—The Forest E. Gilmore Company recently completed an absorption natural gasoline plant at Wetumka, Oklahoma. The plant is handling 10,000,000 feet of gas from two oil wells on leases belonging to the W. C. Newman Corporation and the Fuhrman Petroleum Company. Production is about 3000 gallons daily. The Gilmore Company is now installing three more small natural gasoline plants in the Bowlegs pool area of greater Seminole, which will be in operation in the near future.

Ponca City, Okla.—Marland Refining Company has purchased five of the old Flemming cracking units that were formerly operated at the plant of the Barnsdall Refining Company, Wichita, Kansas. The Flemming stills are now being dismantled and moved to Ponca City.

Complete Montana Plant

Harve, Mont.—The Milk River Refineries, Inc., has about completed construction of its 750 barrel refining plant. The company expects to begin operations October 1.

Improvements Made in Calorizing Process

The Calorizing process, covered by General Electric Company patents for which the Calorizing Company is sole commercial licensee, is familiar to most oil refiners. During the past two years, the process has been modified and improved with specific reference to the production of heat enduring and corrosion resisting tubes for cracking still service.

The immunity of Calorized steel to oxidation up to maximum metal temperatures of 1650 degrees F. is well known. Extenivse tests conducted by Messrs. Robert E. Wilson and W. H. Balke at Whiting, Indiana, indicate the product to be immune to corrosion caused by sulphur compounds in crude oil. The results of the Whiting experiments are indicated in the appended table:

Tests in Pressure Stills*

Metal	Loss Mg./sq. cm./run	No. of runs
Aluminum	None	60
Calite casting	None	60
Calorized plate	None	50
Duralumin	None	10

*Data reprinted by permission of Industrial and Engineering Chemistry.

Stainless steel (Firth-Sterling)	0.03	33
Ascoloy	0.03	94
Iluminum bronze	0.11	38
Galvanized iron	0.55	50
Zinc	0.60	10
Cast iron	2.73	30
Vismera steel	2.96	10
Special Climax alloy steel	3.32	33
Still-bottom steel	3.44	30
Copper-bearing steel	3.49	10
Low chromium alloy Steel	3.68	20
Wrought iron	3.69	10
Monel	3.85	10
Bronze	19.25	10
Brass	21.8	10
Copper	40.6	10

Unlike plated material or the coated product, the Calorized tube does not obtain immunity to oxidation and corrosion by virtue of a super-imposed layer of aluminum. In the type of Calorizing developed for cracking still tubes the aluminum is driven into the surface layer of the steel forming an iron-aluminum alloy. It is this alloy, an integral part of the steel, that resists both oxidation and corrosion. The alloy surface is much harder than mild steel and under the action of the tube cleaner assumes a high polish.

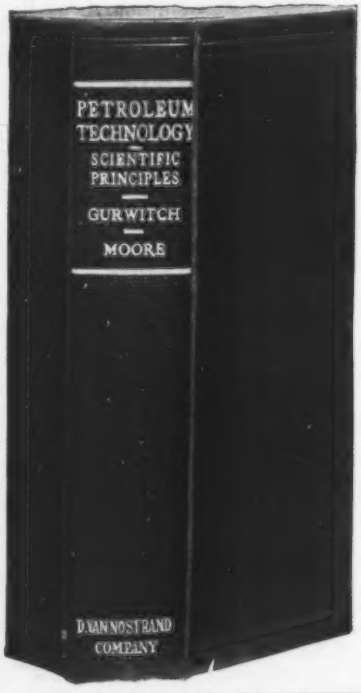
Under present manufacturing processes, cracking still tubes which are to be Calorized are first thoroughly pickled in hot sulphuric acid to remove all traces of scale. This affords an excellent opportunity for careful surface inspection of the steel and detection of injurious defects. The pickled tubes are sandblasted to complete cleaning of the exterior surface. The interior is ground and wire brushed to provide a smooth, clean surface.

Upon completion of these preliminary operations, the tubes are loaded into a cylindrical retort and packed in Calorizing compound. To insure uniform distribution of compound in proper quantity throughout the interior of the tube, a spoon running the entire tube length is employed. When loading has been completed, the heads on the retort are hermetically sealed and throughout the remainder of the process the tubes are maintained in a hydrogen atmosphere. The loaded retort revolves within a furnace, the temperature of which is carefully maintained during the entire operation.

A test piece is processed with each heat. This consists of a 1 5/16-inch seamless tube of the same length as the cracking still tubes which are being processed. The test tube is run inside one of the larger tubes and, thus, exactly represents the quality of Calorizing which has been secured on the interior surface.

Upon completion of the Calorizing operation, the tubes are removed from the retort and thoroughly wire brushed to remove excess Calorizing compound from the exterior and interior surfaces. The ends are finished by grinding, the diameter and roundness being checked with a ring gange to insure proper assembly in the tube sheet. The full length test piece is turned over to the laboratory. Samples are cut from the center and both ends for oxidation test and examination of the Calorized surface. The heat is not released for shipment until the samples have successfully meet the prescribed test.

Calorizing finds many other uses in the oil refinery. Vapor lines, valves, fittings, burner tips, header plugs, pyrometer protection tubes and bubble tower parts are representative, successfull applications of the Calorizing process in refinery service. In some applications, particularly those involving articles of unsymmetrical contour, protection against oxidization and corrosion is required but abrasion, such as that encountered in the cleaning of cracking still tubes, is not a factor. Such parts are finished by a modification of the Calorizing process which provides a heavy layer of pure aluminum with lustrous finish.



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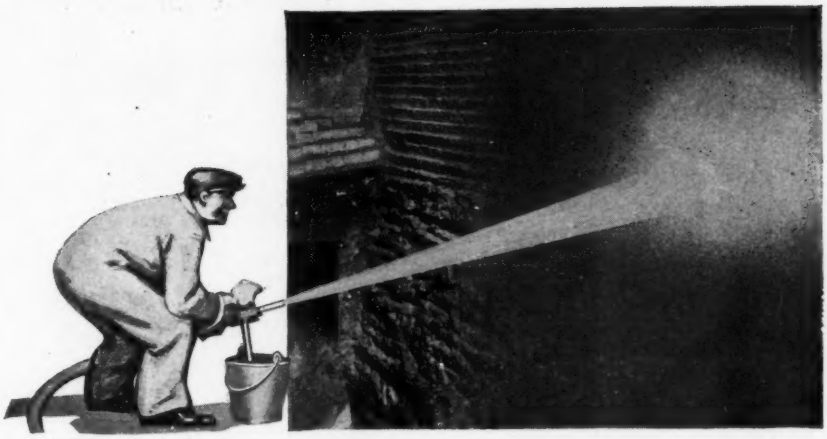

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Siren Provides Definite and Insistent Signal in Refining Plants

By F. A. ORTH

What, perhaps, is one of the greatest hazards confronting refineries is that of fire. A small blaze not brought quickly under control a hundred or more feet away from highly inflammable oils and gasoline may create untold havoc.

With fire hazard such as this confronting refineries it is imperative that those responsible for the safeguarding of lives and property in this particular industry take every possible precaution.

There are, of course, three things to do toward reducing the fire hazard. The first is that of taking all possible preventative measures. The second is that of making adequate fire fighting equipment available; and the third is the providing of signaling devices which will warn instantly, and in unmistakable terms, when there is a fire.

To sound the alarm many outstanding refineries have adopted the electric siren. There are several reasons for this. One reason is that its sound is universally associated with fire and its distinctive tone is recognized instantly as the alarm; another is that its weird, penetrating screech cuts through all other noises and is never mistaken for other signals such as bells, gongs or whistles in some other plant; and a third reason is that its sound-radius is unequaled by any other signaling device. When the siren sounds the men instantly recognize the alarm and get to the fire on time.

Another use to which the same sirens installed for use as a fire and general emergency alarm may be used, is that of getting employes to work on time. The usual excuse offered by an employe when he is late is that he did not hear the start-work signal. Or, hearing it, he did not recognize it as the start-work signal for his particular plant. The distinctive, penetrating sound of the electric siren eliminates these excuses and the men get to work on time.

Sirens used for fire and general emergency alarms and as start and quit work signals may be divided into two groups; those for use indoors and those for use outdoors. The siren used inside the plant is usually the one-third horsepower siren; those used outdoors, the one and five-horsepower sirens.

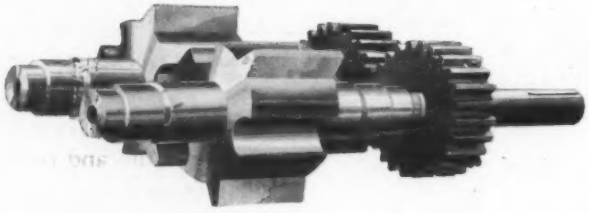
The smaller siren for use indoors may be erected on supporting columns or in any location occupied by other signaling devices. The number of units to be installed is determined by the amount of noise in that particular section of the plant. Regardless of the number found necessary, one siren will supplant from two to three ordinary signals. The one-third horsepower siren is entirely weather-proof and may also be installed outdoors if desired. It has a sound radius of one-fourth mile.

The one-horsepower siren which is used primarily outside the plant consists of three one-third horsepower sirens mounted on a triangular base. With a siren

mounted on each angle of the base the sound penetrates in every direction and will serve an entire plant of ordinary size. It has a sound radius of one-half mile.

The five horsepower siren is for larger plants and has a sound radius of two miles. One of the outstanding features

Scientifically Designed Rotors Provide For Long Life



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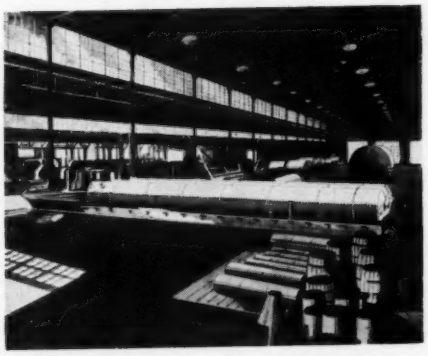

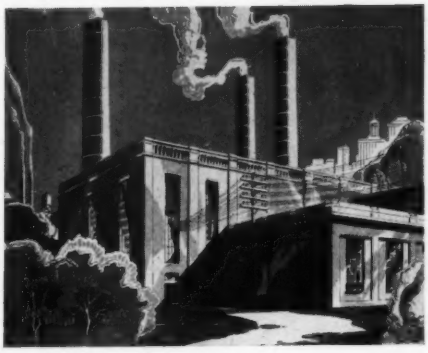

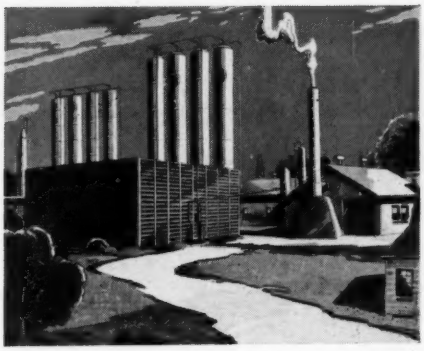

The One is Built Upon the Other

THERE is no business which can prosper by itself alone. Progress comes when industries build each other up through each doing well his particular kind of work and keeping men and materials on tap for the demands that arise.

The utility has power and light on tap for the oil man, but uses oil and oil products in large quantities. The oil man uses every conceivable product, and in turn every industry and every individual is a prospective customer.

Here, in the Southwest, a number of big businesses have grown to full size through the parallel success of other industries all around them. It is a development that is now going on right before us.

Wyatts, devoted to supplying industries with fabricated metal, has been able to build and expand through the equal success of the oil and refining companies, the utilities, the general manufacturers, the builders and the people's own public improvements.

And, in turn, the equipment, experience and consuming power of the Wyatt organization has had its share in aiding industries in the section to keep the upward stride.

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of the five horsepower siren which is not common to the smaller units is that it may be had to sound code signals. When used during work hours to sound a fire or general emergency alarm it tells at the same time, by code, where the fire or accident occurred.

The upkeep of the five horsepower electric siren, including electricity, is less than two dollars a year. This assumes that the unit will be sounded an average of four times a day—once in the morning, twice at noon, and once in the evening—for a length of time of 15 seconds on each occasion. The upkeep of the smaller sirens are proportionate.

The electric siren seems to most satisfactorily meet all reasonable conditions of application and operation. It can be installed out of doors without any special measures for protection being taken. It is fool-proof in its operations, and the operator need not go near the siren except to put oil in the bearings.

For best results an outdoor siren should be installed at least 40 to 50 feet in the air and 10 to 15 feet above any roof or other flat surface. It should be above near by buildings or trees. The reason for such installation is that a roof or other flat surface directly below a siren acts as a sound-board and throws the sound the sound waves up in the air instead of distributing them over an extended area. In fact, this is true of any vibratory signaling device. In order that the sound may not be absorbed or misdirected, the siren should be in the clear.

When properly installed both with regard to location in a given physical contour and also as to elevation and proximity to roofs and nearby buildings and trees, the electric siren invariably performs satisfactorily. It is easy and inexpensive to install and operate, distinct and penetrating in its tone, and always available for instant use.

More and more each day are refineries coming to realize the outstanding advantages of the electric siren as a fire and general emergency alarm and as a start and quit work signal; consequently, more and more each day are refineries throughout the country adopting this unit with a resulting decrease in fire hazard and in lost time and lost production.

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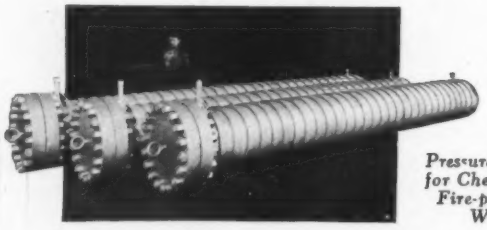

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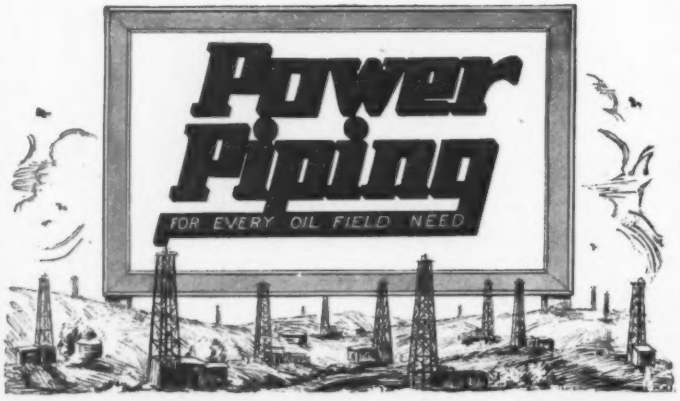

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Gasoline Booklet

A profusely illustrated book has just been published on the process of natural gasoline absorption by J. A. Campbell, natural gas engineer of Long Beach, California.

The book delves into the many factors involved in extraction of gasoline from natural gas and is profusely illustrated, showing views of every part of a natural gasoline palnt, including close up illustrations of absorbers, strippers, interchangers, scrubbers, inlet and outlet lines, pumping mechanism, arrangement of cooling coils and dephlegmators.

The cycle of operation starting with the gas coming from the well, passing through the absorber and changed to dry gas and also the manner in which the gasoline is handled and treated after being removed from the natural gas is described in understandable language that any layman can comprehend.

A complete explanation is made of the manner in which billions of bubbles are used to absorb gasoline.

It is interesting to note that computation is made of the amount of oil film contained within a given area within an oil froth absorber. The writer estimates that within one cubic foot of oil froth is contained 603 square feet of oil film.

Copies of the book were available on September 15. Copies may be obtained from the publisher.

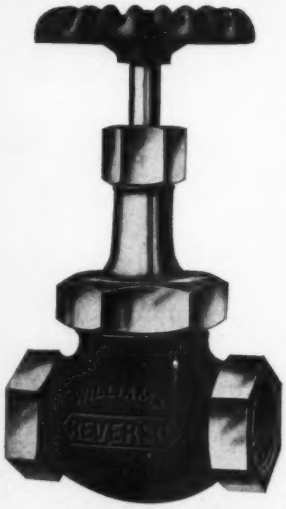
The methods of using lubricating valves within gasoline refineries and for other refining purposes is shown by illustration and described by text matter in a pamphlet just issued by Merco Nordstrom Valve Company. Pamphlet features gasoline plants and also fully describes the function of Merco valves. Copies may be obtained by writing direct to the manufacturers' offices at 121 2nd Street, San Francisco, California.

Midwest Piping & Supply Company announces the establishment of a pipe fabricating shop in Los Angeles, California.

Throw out Repair Bills

Bills of that kind have one beneficial effect, at any rate. They make the shrewd executive think! From thinking to investigation is a short step. He wants to know the why—the reason for the bills. When found he can apply the brakes and stop them.

Ninety-nine times out of 100 the "why?" will be found in the valves. Originally these were chosen for their cheapness—the small initial outlay required for them.

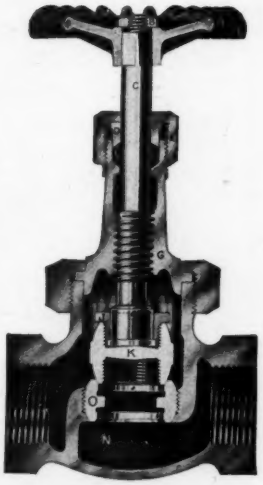


No. 780 REVERSO Valve
For 200 lbs. pressure and total temperature of 550° Fahr. A long lived valve which outlasts the ordinary valve on account of its higher seat vitality. Figured on the cost per year of leak tight service, it wins its way with the closest buyers. Reversible—Regrindable—Renewable, REVERSO has every element necessary to long life and low maintenance costs. Once in the line, the Reverso is there to stay—no more replacements or excessive upkeep expense—no wastage or production losses to drain away profits.
Order a sample from your dealer.

"Penny wise and pound foolish." Those cheap valves have proved terribly expensive. Under high pressures and temperatures they have collapsed and been repeatedly replaced. They have leaked and wasted steam steadily. They have caused numerous shutdowns and loss of production—to say nothing of much greater coal consumption.

The shrewd executive replaces his cheap valves with high-grade, and naturally chooses Williams Valves. He knows the Williams Company builds valves that last. That its product represents many years of experience in valve problems. That Williams Valves are dependable, durable and economical. That material and design qualify them for superior service. That they stop repair bills.

Abroad or at home—that is the story told of Williams Valves by all progressive plants. Why they have a world-wide reputation is described in our Catalogue 10. Write for a copy.



No. 780-S REVERSO Valve
Interior view of Reverso Valve. Note each detail—The wear-resisting, nickel alloy disc and seat—the reversible feature—the full free area—the union ring which secures hub to body and facilitates regrinding when necessary—the non-stripping stem which is gland packed and which is easily repacked under pressure when wide open. A non-heating wheel firmly lock-nutted to stem provides easy and comfortable operation.

The D. T. Williams Valve Co.

Cincinnati, Ohio

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Valves

Mention Where You Saw the Advertisement

Unloading Sulphuric Acid Cars by Compressed Air

EVERY petroleum refiner encounters the problem of unloading sulphuric acid, since sulphuric acid is required for chemically treating volatile petroleum distillates, naphthas, kerosene, etc., as well as for lubricating oils. Sulphuric acid, which is generally shipped in tank cars holding about 8,000 gallons, is usually unloaded by the petroleum refiner by means of compressed air.

In this connection some charts and data on this subject, given by L. G. Jones, Baltimore, Maryland, in an article appearing in the August, 1927, issue of Chemical and Metallurgical Engineering, become of interest and of value.

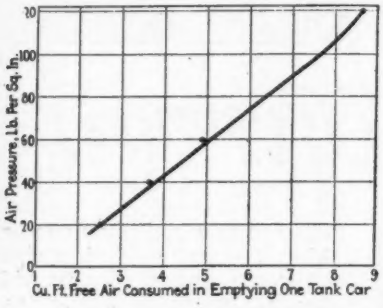
Figure 1 is a curve showing the time required to empty cars using air at different pressures.

Figure 2 is a curve showing the rate of flow of air into tank cars.

Figure 3 is a curve showing the total quantity of air consumed in emptying tank cars. Attention is called to the fact that more air is consumed by using high pressure air, in spite of the short time required to empty the car.

Concerning the time required to empty cars using air at different pressures, Mr. Jones states:

"When our air pressure was low, it took considerable time to unload the cars. The time required increases rapidly as the pressure of air is lowered. The reason is obvious, as the higher the pressure on the acid, the more rapid will be the flow of liquid through the pipe line to the plant storage tanks, thus decreasing the time required to empty the tank car."



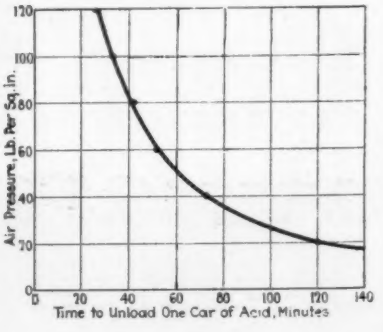
Concerning the rate of flow of air *into* the tank car, Mr. Jones further states:

"As would be expected, the higher the air pressure, the greater the flow of air per minute into the tank car, provided the liquid is moving out of the tank at a correspondingly higher rate. In other words, the higher pressure air not only gives a greater differential and velocity into the tank, but makes more room for additional air by the more rapid delivery of air from the tank."

In concluding his discussion, Mr. Jones comments as follows:

"One of the most interesting features

(*Abstracted from article on this subject by L. G. Jones in August, 1927, issue of Chemical and Metallurgical Engineering.)



What Does Guesswork Cost You?

ADJUSTING valves by hand cannot be depended upon for accuracy in maintaining correct temperatures. At best, this method can be only approximate. The most skilled men can do no more than guess—and it is human nature to forget. Sarco Temperature Regulator puts a stop to guesswork. Once set for a given temperature, it maintains that temperature **always.** It never varies.

The Sarco is inexpensive to buy and install. No expensive pipe lines needed. It is entirely self-contained. Requires no compressed air, water pressure or electricity to operate.

It is also inexpensive to maintain. Has nothing to get out of order.

Works on steam, gas or hot water heat within any range between 30° and 300° F.

Test it 30 days free

Put Sarco on the job for 30 days. If it does not prove its case, return it and don't pay us a penny.

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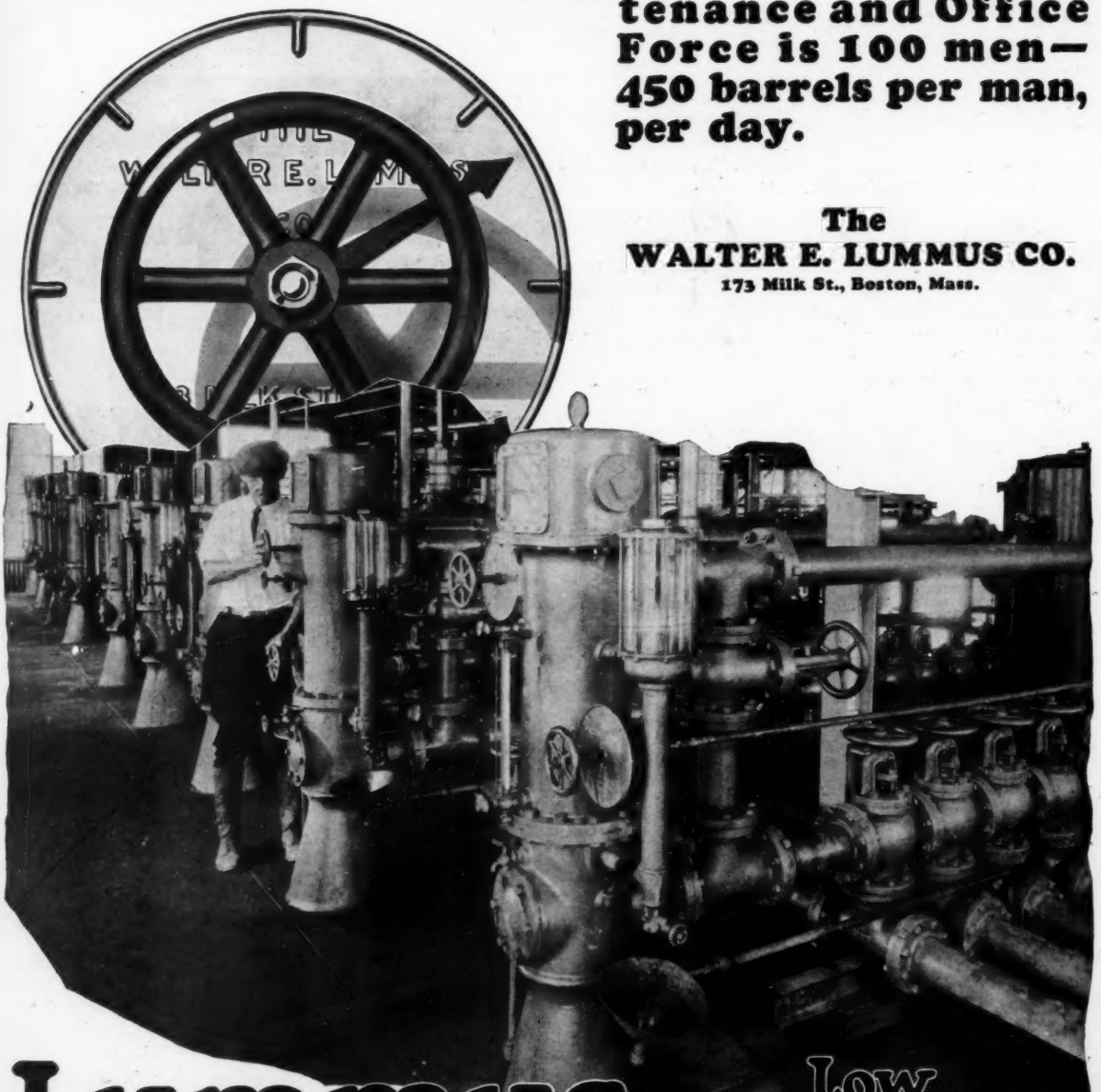
SARCO Temperature Regulator

Reduce Your Operating Costs!

For example—at the refinery of the Richfield Oil Company, averaging 45,000 barrels per day throughput, the total Operating Labor, Maintenance and Office Force is 100 men—450 barrels per man, per day.

The
WALTER E. LUMMUS CO.
173 Milk St., Boston, Mass.



Lummus Low Temperature Refining Systems

One of our Spray Nozzle Cooling Systems in operation at the plant of a Louisiana oil refinery. This spray pond is equipped with our Impact Type spray nozzles.

Spray Ponds for Refineries

ONLY a nozzle that will not clog will do for refining plant spray pond installations. The need for a plentiful supply of cooling water at all times is too great to take chances with a nozzle that may clog after a few months. In our Spirodome Nozzle the orifice is larger than that of the ordinary spray nozzle, thus eliminating all danger of clogging and the need of frequent cleaning.

Our new Bulletin 262-R describes this nozzle, also our Automatic Drain and Flush-out Valve (Is your pond equipped with one?) and our other spray pond equipment.

Write for Literature

Our company is composed of engineers whose long experience with cooling water problems entitles them to your confidence. We have designed and built cooling towers and spray nozzle cooling systems for firms like Marland Refining Company, Union Oil Company, Roxana Petroleum Company and others equally well known.

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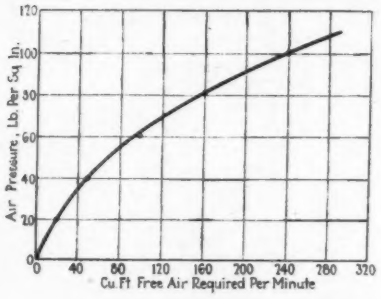
of these curves is the variation in compressed air consumed at different air pressures. This, of course, is compensated for in the saving of time in unloading, which time may or may not be worth more than the extra air consumed.

"The following table illustrates this point:

Air Pressure Lb. Gage	Air Consumed in Emptying Tank Car Cu. Ft. free air	Time Taken in Emptying Tank Car Minutes
20	2400	120
60	4900	52
100	7600	33

"Three times as much air of 100 pounds pressure is required to empty the car in almost one-fourth of the time taken under conditions of air at 20 pounds pressure.

"Figure 3 shows that the quantity of air required to empty tank is almost exactly the volume of the tank car in cubic



feet, which, corrected to atmospheric pressure from the given air pressure, gives the free air. For example, an 8000 gallons tank is equivalent to 1,066 cubic feet. This calculates, in terms of free air, as follows:

Air Pressure Lb. Gage	Correction factor to Atmospheric Pressure	Free Air Equivalent Cu. Ft. Corrected Air
0	1.0	1066
20	2.67	2482
40	3.67	3900
100	7.33	7812

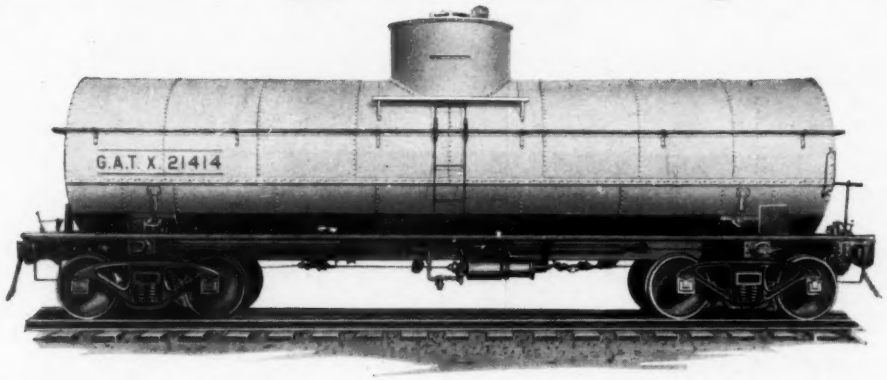
How Coke is Handled at the Marland Refinery

(Continued from page 72.)

petroleum coke is a very desirable fuel. Marland Company has in storage at the present time some 30,000 tons, is producing between 220 and 230 tons per day and shipping between 400 and 450 tons a day, in addition to burning considerable amounts under it own boilers.

Some interesting points in connection with petroleum coke have been developed recently by several research laboratories connected with state universities. One chemist has determined definitely that petroleum coke contains in varying amounts the following metals: Vanadium, Tin, Lead, Cobalt, Gold, Uranium and Silver. One scientist even goes so far as to believe that the combined value of these metals may very possibly be such as to make their extraction commercially feasible.

EFFICIENT DEPENDABLE SERVICE



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"The Only Regulator that actually regulates over its entire capacity range."

A General Superintendent remarked while watching a Buck 6-inch casinghead regulator make a perfect chart while passing but 1,500 cubic feet per hour, and maintaining mercury vacuum at intake. Such accurate regulation on but 1½ per cent of its actual capacity is characteristic of all BUCK Regulators. They are absolutely and scientifically correct and immediately sensitive to the slightest pressure.

Write for Bulletins.

Gustin-Bacon Mfg. Co.

Vacuum Control Division

Kansas City, Mo. Tulsa, Oklahoma

Forgotten Chapter of Oil History

(Continued from page 70.)

to blame our early legislators for their attitude in the matter as it is very reasonable to assume that their laws were enacted and enforced for the benefit of the traveling public. More than one serious fire aboard steamer and train was caused by the use of a dangerous and defective lamp in which kerosene was burned. Some of the fires, too, were caused by sheer stupidity of those in charge.

The refiners and marketers had to tear down this wall of prejudice. They accomplished it, largely by supplying a better and cleaner grade of illuminants and by supplying, at a normal cost, adequate and efficient lamps—dealers became more than vendors of lamps and kerosene—they became educational agents. The American public has always been prompt to adopt that which had merit. When the walls of prejudice crumbled kerosene swept into high public favor. The lubricating oils never faced any real bias, consequently they were readily marketed and achieved their first fame as railroad lubricants; quickly other mechanical phases of industry adopted the new lubricants and the price of tallow and sperm oil hit bottom with a dull thud. "Signal oil," which happens to be another name for kerosene, was used in great quantities by the railroads and found to be superior to any other oil ever used.

Pioneer Refineries

It is indeed difficult to say with any degree of certainty just who was the most important of all the pioneer refiners and marketers. Without detracting from the achievements of Downer, Gesner, Merrill or others, the writer calls particular attention to Colonel C. A. Ferris of New York, of the firm of C. A. Ferris & Company. This gentleman deserves no small portion of credit both as a refiner and as a marketer. His organization survived many disasters including fire and accident. At one time he was forced to move his plant because his neighbors objected to the strange and unsavory odors caused by the distillation and refining of the oils. Ferris deserves honor for several accomplishments. In the first place he was the first marketer who actually sold "carbon oil" made from petroleum and included with each shipment an invoice of lamps designed to burn the oil; such shipments were made to dealers on a "keep or return" basis and the volume of rejections of orders would have discouraged a man of lesser courage. Ferris it was who sold the first shipment of "carbon oil" to a dealer, the buyer being the firm of Stout & Hand of South Brooklyn and the consideration being 75 cents a gallon for a barrel that contained a little over thirty-one gallons. It was Colonel Ferris who paid out the money for the first oil advertisement—a sum of $24 being paid to Orange Judd "Agriculturist" for space for the account of one Alexander Muir, an agent of Ferris' organization. This, mind you, in September of 1858! The oil then being sold by the Ferris organization was a crudely distilled "carbon oil" made from the petroleum that entered the salt wells at Tarentum, Pennsylvania. Colonel Ferris, a big man physically and mentally, deserves more credit than has ever been given him. He was a real pioneer; he established methods that were sound in every respect; methods of distilling, methods of refining; methods of storage, methods of distribution. He had vision, foresight and an uncanny sense of the possibilities of the market that might be made to exist for refined products, an illuminant in particular. Into his dreams he put all of his funds, his abundant energy, his ability to think along constructive lines and his capacity for shouldering responsibility in times of stress and depression.

This closes a brief chapter of oildom; it is a short chapter but it has a significant import. Drake established the feasibility of the adoption of a simple mechanical process to reach an oil-bearing sand. The "coal oil" refiners, the distillers of "carbon oil" and the early marketers really did the important work because they established, first, a method of manufacturing the crude product into a usable and needed commodity; and second, they succeeded in establishing a method of distribution that absorbed the fast-growing output. Without these two factors the petroleum industry would have expanded very slowly—if at all.

Complete Adjustment for Changed Wind Requires Only Five Seconds Time of One Man

All Adjustments Made From Ground

Note These Direct Advantages:

1. Greatly Increased Effective Cooling Surface.
2. Decided Up-Circulation of Air, Improving Performance.
3. Reduced Size of Complete Tower.
4. Reduced Pumping Head, Saving Power.
5. Reduced Foundation Expense.
6. Reduced First Cost Per Gallon of Water.
7. Reduced Windage Loss, With Resultant Saving in Make-Up.
8. Elimination of Water Spray Nuisance.

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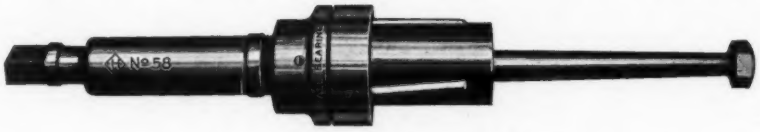

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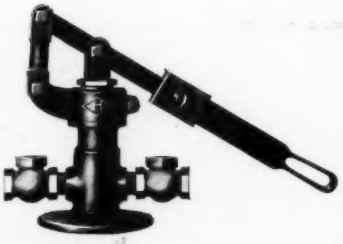

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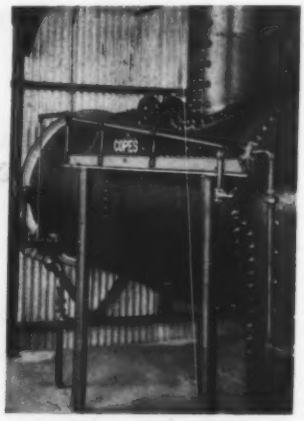
Methods of Refining Shale Oil Studied After Closing of Experimental Plant

FOLLOWING the recent closing down of the experimental oil shale plant of the United States Bureau of Mines, Department of Commerce, near Rulinson, Colorado, studies of the best methods of refining shale oil are being made at a number of institutions. Two 6000-gallon tank cars of shale oil produced at the plant have been shipped to the League Island testing plant of the Navy Department, where tests will be made to determine the suitability of raw shale oil as fuel for naval vessels. This represents the first tank-car lot shipment of shale oil made on the north American continent. Approximately 150 barrels of the oil produced were sent to the Boulder, Colorado, laboratory of the United States Bureau of Mines, where studies are being made in a $10,000 experimental refinery erected by the State of Colorado. A total of about 100 barrels of shale oil has been shipped to a number of oil refineries and laboratories, where studies will be made to determine the best methods for refining this oil. The results of these investigations will be made known to the Bureau of Mines. The experimental plant was shut down on June 30, due to the failure of the second deficiency bill, which contained an item of $70,000 for continued operation of the plant.

The experimental oil shale plant was built as the result of the recommendation of the President's Naval Oil Reserve Committee that information be obtained as to the value of the naval oil shale reserves as future sources of oil for the Navy, especially in time of national emergency. The oil shale plant was designed particularly for the purpose of determining fundamental principles that should be followed in extracting oil from oil shale. It was believed that by building a semi-commercial plant, so far as possible of time-tried units, and making use of the data obtained by the Bureau of Mines in laboratory study of oil shale extending over a period of several years, it would be possible to determine the quality and quantity of oil that could be obtained in an emergency and to obtain information that would be of value to an oil shale industry of the future.

An appropriation of $90,000 for this work became available on March 3, 1925, and an additional appropriation of $89,000 became available on July 1, 1926, to take care of plant operations during the fiscal year ended June 30, 1927. As soon as the first appropriation was made, a site was selected for the retorting plant on Naval Oil Shale Reserve No. 3. A site for the mine was selected on Naval Oil Shale Reserve No. 1, adjoining Reserve No. 3. Before construction work could be started, it was necessary to build a road from the highway near Rulinson, Colorado, to the plant site, a distance of approximately one and one-half miles and to construct a trail up the side of the mountain from the plant to the mine site, a distance of approximately three miles. The road was built by Garfield County, Colorado, and the cost of the trail was borne by the State of Colorado.

Shortly after the original appropriation became available, M. J. Gavin, engineer in charge of the oil shale work of the bureau, was sent to Scotland and France, where he made a study of the methods that have been followed in extracting oil from shale for a long period. While in Scotland, Mr. Gavin purchased a Pumpherston retort, the type of retort that has been used in Scotland and which is the result of over 70 years practical experi-



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A simple, rugged, accurate and continuous boiler feed water input.

Even distribution of load between boilers.

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Higher overload capacity.

Smooth, constant rate of feed with no spasmodic opening and closing of the feed valves.

Drier steam, since the water level cannot rise beyond a predetermined point.

Elimination of boiler priming and wet steam at the filter department.

Labor saving.

Reduced stress on boiler feed pumps, feed lines and valves.

Send for a copy of "Advantages of Boiler Feed Water Regulation in the Oil Industry" written by L. L. Baker, Chief Engineer of the Barnsdall Refining Company.

NORTHERN EQUIPMENT CO., 620 Grove Drive, Erie, Pa.

Stock carried by:
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Absolutely prevents *deterioration inside cracking drums* by Holzapfels Heat Proof Protective Efficient Protection against Hydrogen Sulphide on under side tank tops by Rubshell priming with Rubshell No. 2.

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CRACKING PROCESSES

The EMPIRE Made to withstand working pressures of 300 pounds to the square inch. Special types can be furnished for higher pressures if required. Standard models for general use will sustain a working pressure of 150 pounds. Sizes range from ⅝ inch to six inches, and are supplied either with clock-like vertical dial, or a horizontally placed straight reading register.

The EMPIRE is a positive displacement meter, operated by an *oscillating* piston. It is accurate, and *stays* accurate.

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ence in oil shale retorting. This retort was shipped to the United States and erected at the plant site under the supervision of an expert construction man who was brought from Scotland for that purpose. The work of erecting this retort and auxiliary equipment was started in November, 1925, and completed in the spring of 1926. Another retort, the N-T-U, using quite different principles and of American design, was also purchased out of the original appropriation of $90,000 and the work of setting it up on the plant site was completed in December, 1926. The two retorts form a good combination for experimental studies in that the Pumpherston retort exemplifies slow distillation and the N-T-U retort rapid distillation. In addition to the two retorts and auxiliary equipment, the experimental plant consists of a water-supply system which pumps water from the Colorado River, about one and one-half miles from the plant, two 35-horsepower boilers, a 40-horsepower gas producer, a five-kilowatt turbo-generator for plant lighting and laboratory power, two 250- barrel storage tanks, six 25-barrel receiving tanks, a small pipe still for recovering scrubber naphtha, machine shop, control laboratory, temporary office building, and temporary quarters for plant employes. A 5600-foot aerial tramway was constructed for transporting the shale from the mine to the retorting plant. Other equipment includes a crusher, gasoline engines, mine cars, mine scales, air compressor, rock drills, etc.

After preliminary heating extending over a period of about three months to thoroughly dry the retort and settings, the first run on the Pumpherston retort was started on September 17, 1926. This retort was operated continuously from that date until midnight of June 30, 1927, with the exception of a few weeks during the months of November and December, when difficulties were encountered in keeping the tramway in operation, and for brief periods of a few hours each during the remainder of the time when it became necessary to shut down the retort due to difficulties encountered in handling coking shale. The first run on the N-T-U retort was made on January 17, 1927, and it was operated intermittently until June 1, 1927. Considerable difficulty was encountered in keeping the retorting plant in operation during the winter months of 1926-27, due to the fact that the worst weather that has occurred on the western slope of Colorado for the past several years was experienced. Because of the numerous blizzards and extremely cold weather, it was impossible to bring down sufficient shale from the mine to keep both retorts in continuous operation.

During the time that the plant was operating, a total of 2009 tons of oil shale was run through the retorts, yielding a total of 891 barrels of oil. This is equivalent to an average yield of 18.6 gallons per ton. The shale charged to the retort had an oil content of from practically nothing to some material containing as high as 75 gallons per ton on assay tests, although the highest average yield for a single day's operation was 42 gallons per

Universal Mist Extractor

Endorsed and adopted by Producers, Refiners and Engineers BECAUSE

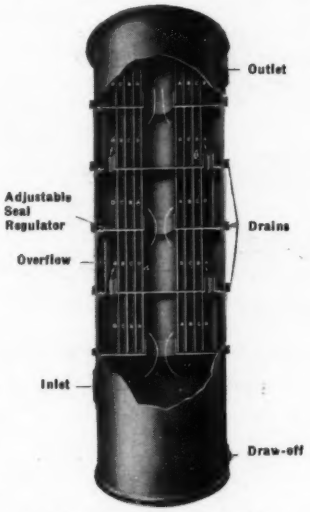
It provides **CLEAN** gas for the Absorption or Casinghead plant.

Does away with **LIVERED** absorption oil.

PREVENTS stills from **FOAMING.**

It insures **CLEAN** gas for distribution lines and **ADDITIONAL OIL** for the producer.

Removes **WATER** from gas leaving Charcoal Absorption Plant.



White Arrow Shows Path of Gas

It will, in refineries, result in lower end points, less treating and higher yields.

Can be used to remove suspended oil from "tail-house" gases.

Can be installed for pipe or cylindrical stills to remove all unvaporized oil held in suspension before vapors reach dephlegmators.

It operates under pressure or Vacuum.

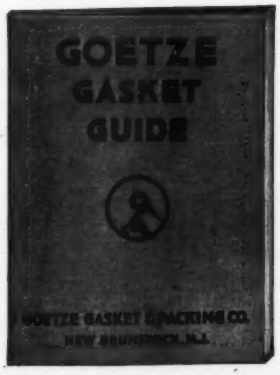
It operates without excessive back pressure.

For sizes, specifications, prices and further information write to

OIL ENGINEERING COMPANY

WRIGHT-CALLENDER BUILDING LOS ANGELES, CALIFORNIA

GOETZE



Metal-Asbestos Gaskets *for* Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.

28 Allen Ave., **New Brunswick, N. Y.**

McKim Metallic Asbestos Gaskets

COPPER

ALUMINUM

MONEL

ARMCO

Plain or Corrugated

Catalog No. 17 on Request

McCord Radiator & Mfg. Co.

Manufactures of McCord Force Feed Lubricators

DETROIT, MICH.

California—Chandler & Warden, 121 West Pico St., Los Angeles

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request.

B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.

ton. The oil shale used came from a quarry at the outcrop of the shale on the escarpment about 2700 feet above the plant. A thickness of approximately 60 feet of the shale escarpment was mined, which included the rich "mahogany ledge."

The oil produced by the Scotch retort had an average gravity of about 28 degrees A. P. I., and yielded an average of about 25 per cent gasoline and naphtha. The oil from the other retort had an average gravity of about 21 degrees A. P. I., and had a gasoline-naphtha content of about 8 per cent. The gasoline-naphtha fraction from both crudes was deficient in low boiling fractions, and it would be necessary to blend the product with more volatile material in order to produce a finished motor fuel. Experiments demonstrated that additional quantities of gasoline could be made from shale oil by cracking. Due to the high content of unsaturated hydrocarbons and nitrogen compounds, the distillates from shale oil are difficult to treat in order to produce commercial products. The work on refining shale oil is being continued at the Boulder laboratory in co-operation with the State of Colorado.

As a result of the two years work in building and operating the experimental plant, the Bureau of Mines has obtained valuable information on such questions as drilling and shooting oil shale, the effect of retorting conditions on the yield and quality of oil, the methods to be employed in refining shale oil, etc.

It was not expected that mining and retorting cost figures could be obtained by continuing operations for so limited a period on such a small scale, but it is thought that the tests demonstrate the value of the naval oil shale reserves as potential sources of naval oil fuel supplies. The retorting studies will point out the principles to be followed in designing retorts for handling Colorado oil shales. An exhaustive report, covering the results of this experimental work, is now in course of preparation. The plant will remain closed until authority is granted by Congress either to permanently abandon the plant, arrange to have it operated by outside interests, or to have operations resumed by the Bureau of Mines.

Parco, Wyo.—The first two units of the six-unit, 5000 barrel cracking plant which the Producers & Refiners Corporation is installing at its plant in this town are operating at capacity and with entire satisfaction. Other four units are to be completed and in operation within a few weeks.

Glenrock, Wyo. — Continental Oil Company is making a number of small improvements in its plant here. Laboratory is being moved into the old machine shop, and the machine shop is being moved into what was the old boiler house.

SEAMLESS STEEL STILL TUBES

Thousands of Babcock & Wilcox open hearth seamless steel still tubes are in service in refineries throughout the country.

These tubes have been supplied to various specifications, either with plain ends or upset as ordered.

Many of them are thirty feet long, made hot finished by a process perfected by this Company, for tubes of unusually long length.

The more common sizes are carried in stock at the Mill for immediate shipment.

THE BABCOCK & WILCOX TUBE CO

Works: Beaver Falls, Pa.

General Sales Office: 85 Liberty Street, New York

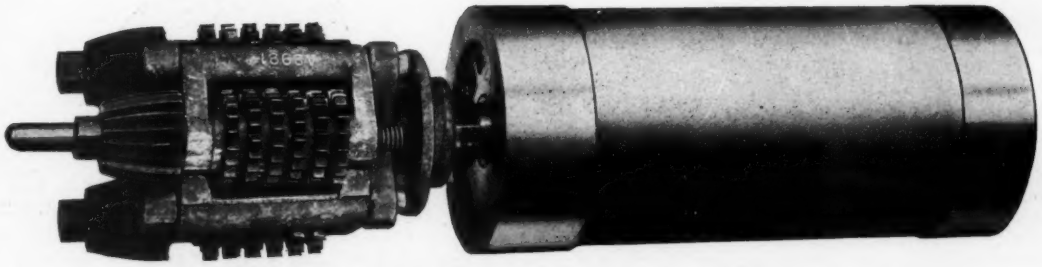
BRANCH OFFICES

CHICAGO .....Marquette Building
BOSTON .....80 Federal Street
PHILADELPHIA ..... Packard Building
PITTSBURGH ...Farmers Deposit Bank Building
CLEVELAND .....Guardian Building
CINCINNATI .....Traction Building
ATLANTA, GA. .....Candler Building
NEW ORLEANS .....344 Camp Street
HOUSTON, TEXAS.....Electric Building
SAN ANTONIO, TEXAS .....
.....511 Builders Exchange Building
DALLAS, TEXAS .....Magnolia Building

BRANCH OFFICES

GALVESTON, TEXAS .....414 Security Building
AMARILLO, TEXAS, ...208 Polk Street
PHOENIX, ARIZONA.....Heard Building
DENVER .....444 Seventeenth Street
SALT LAKE CITY .....Kearns Building
SEATTLE .....L. C. Smith Building
SAN FRANCISCO .....Sheldon Building
LOS ANGELES .....Central Building
PORTLAND, OREGON .....Gasco Building
HAVANA, CUBA .....Calle de Aguiar 104
SAN JUAN, PORTO RICO ..Royal Bank Building
HONOLULU, H. T.....Castle & Cooke Building

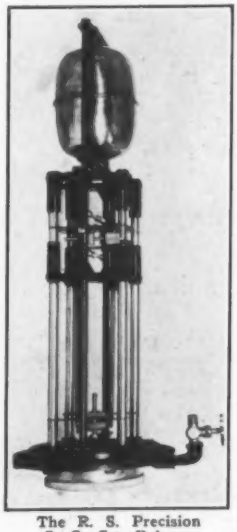
ROTO TUBE CLEANERS



Roto Air-Driven Heavy Duty Cleaner
For

CRACKING STILLS

THE ROTO CO. **Sussex Avenue and Newark St.,** **NEWARK, N. J.**



The R. S. Precision S. G. Gas Balance

THE R.S.C. SERVICE ACCURACY TULSA

For Your Protection
Read This Announcement

We have taken over the H. R. Pierce Patents affecting in any way the manufacture and sale of

Gas Gravity Balances

This enables us to offer you:

Complete protection against any possible infringement litigation.

The ideas of the leaders of the gas industry combined in a balance.

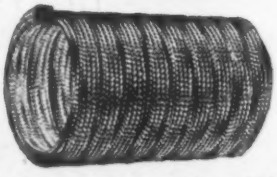
The most substantial and accurate machine manufactured.

Guaranteed service at all times.

The REAL REFINERY SERVICE SUPPLY Co.

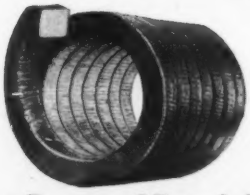
TULSA, OKLA. DALLAS, TEXAS

Outstanding Service in Pumping and Refining



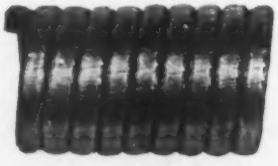
Gas Lift Compressors—Hot Oil Pumps

Style 250, "Craneum," finest packing ever developed on high temperature work. Long service. Temperatures to 1,500° F Pressures to 2,000 lbs.



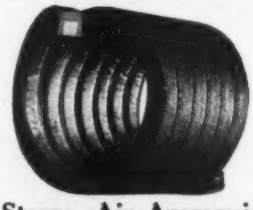
Gasoline Pumps—Mineral Seal Oil

Style 110. Asbestos coil, heavily wrapped with babbitt foil gives resilience. Runs cool and gives long efficient service.



Centrifugal Pumps

Style 150, "Craneum". Runs without friction or abrasion. Has proven ideal in centrifugal work at temperatures up to 450° F.



Steam, Air Ammonia

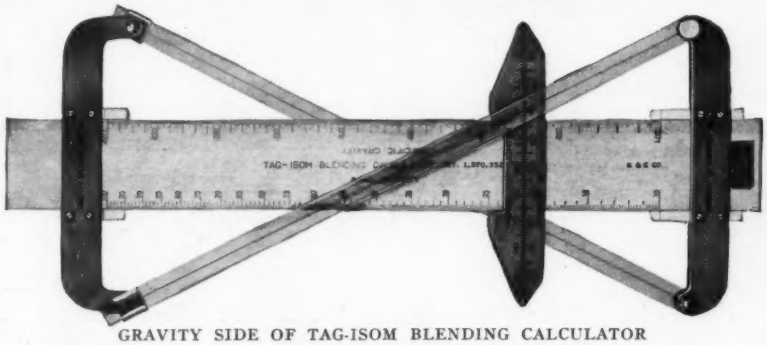
Style 300, gas, air and ammonia compressors and steam. Resilient, non-abrasive. Metallic wearing face. Maximum steam pressure 300 lbs.

Tell us your requirements. We have satisfied them for refinery superintendents everywhere. Order from jobber or direct.

"John Crane" Metallic Packing

Mention Where You Saw the Advertisement

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



GRAVITY SIDE OF TAG-ISOM BLENDING CALCULATOR

Blending Calculator

C. J. TAGLIABUE MFG. COMPANY

C. J. Tagliabue Manufacturing Company, 18-33rd Street, Brooklyn, New York, is putting on the market the TAG-Isom Blending Calculator. It is claimed that this instrument solves the blending problem, either on the basis of viscosity or gravity.

The calculator is about 13½ inches long and six inches wide.

On one side are the viscosity scales, one for oils at 100 degrees F., and the other for oils at 210 degrees F. The other side is used for the gravity calculations, both A. P. I. and Specific Gravity scales.

The outfit is substantially built and is durable as it has no parts to wear out.

Further particulars will be mailed by the company, on request.

Fracto Condenser

C. H. WHEELER MANUFACTURING COMPANY

The Leach Fracto Condenser, being put on the market by the C. H. Wheeler Manufacturing Company, Philadelphia, is essentially a condensing column, designed to separate the condensate into several fractions and to make use of the feed stock as a cooling medium for the recovery of a large amount of process heat.

The condenser consists of an outer shell of cast iron or steel plate, of circular section, approximately ten feet in height and five feet in diameter. Within this shell are a number of tubes of a size calculated to balance velocity of flow and possibility of fouling. These tubes extend vertically from a heavy base or channel casting and are expanded into several floating heads at the top of the condenser to relieve stress due to uneven expansion and contraction.

The channel casting contains a tube sheet into which the tubes are rolled. The top of this casting has integral basins formed upon it in which the distillate fractions collect and from which they are drawn through bleeder pipes. The tubes extend through the casting and communicate with the compartments at the bottom from which the cooling media are controlled.

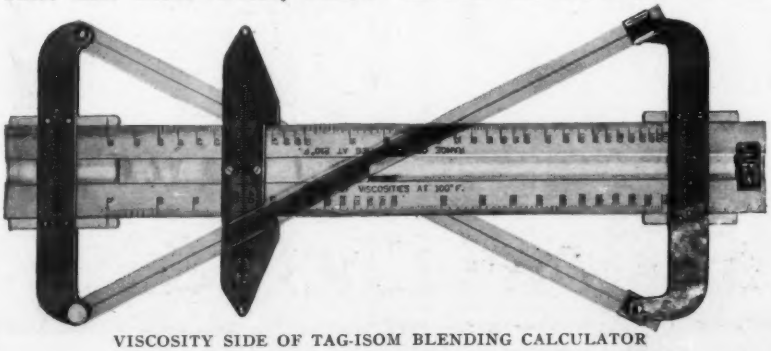
On the lower flange of the channel casting are a series of covers, used to control the path of the cooling medium. Rearrangement of these openings makes it possible to provide for the use of several combinations of cooling effects.

Within the condenser shell and between the blocks of tubes are several vertical baffles to direct the flow of the vapor and to create several compartments for the fractional condensation of the distillates in the vapor. Temperature of these various compartments may be controlled by adjusting the flow of the cooling medium or by use of two or more cooling mediums. In this manner the temperature of the vapor is progressively lowered as it travels through the successive compartments accomplishing a separation of the distillate into several fractions.

The outfit has been designed to reduce corrosion within the shell. Liquid spaces are constructed of close grained cast iron. The tube sheet in the channel casting is provided with bosses projecting upward, which divert the downward flow of the condensate away from the lower ends of the tubes. The shell and shell baffles, because of their vertical position, rapidly drain any distillate deposited on their surface.

The condenser can be applied to both vacuum and pressure stills.

Further information will be supplied by the C. H. Wheeler Manufacturing Company, 19th Street, Lehigh and Sedgley Avenue, Philadelphia.



VISCOSITY SIDE OF TAG-ISOM BLENDING CALCULATOR

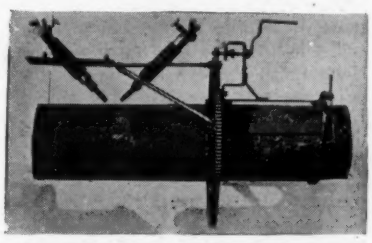
Pipe Cutting Machine

OXWELD ACETYLENE CO.

A pipe cutting machine for use in salvaging old pipe lines is being put on the market by the Oxweld Acetylene Company, 30 East 42nd Street, New York City, New York. The outfit was devised and patented by N. E. Wagner, welding superintendent of the Prairie Pipe Line Company.

The outfit consists of two gears and a framework so arranged that two Oxweld oxy-acetylene cutting blowpipes are carried around the circumference of the pipe during the operation. When the crank handle is turned the action of the gears causes the carriage supporting the two blowpipes to revolve about the pipe.

The blowpipes may be adjusted to any angle of cut desired, although 45 degrees is usual. Distance between the cuts may be varied within reasonable limits. Special Oxweld cutting blowpipes used provide a compact unit which eliminates much extra bell-hole digging. By using different sized internal shoes, the machine may be employed on different sizes of pipe. Thus a machine may be used on four-inch, six-inch, and eight-inch pipe merely by changing the internal shoes. Larger machines may be had if desired.



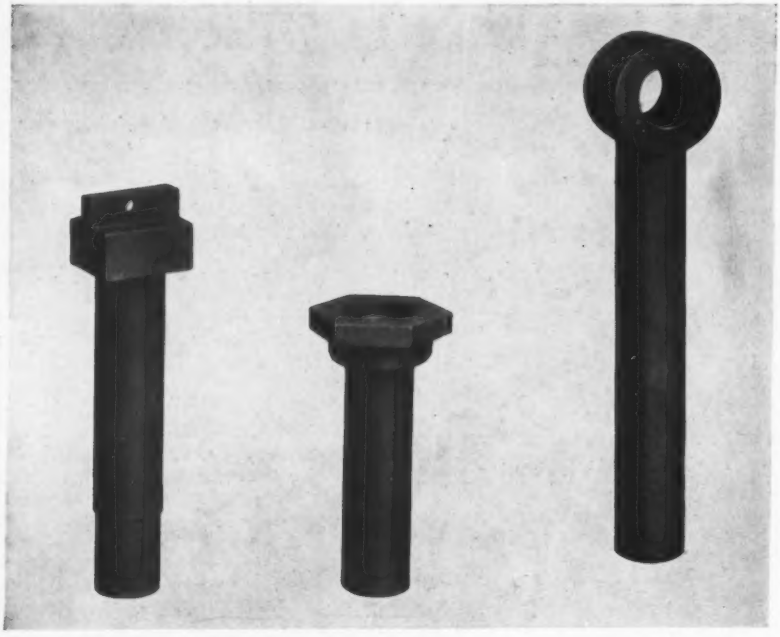
WAGNER PIPE-CUTTING MACHINE

Further information can be had from Oxweld Acetylene Company, 30 East 42nd Street, New York City, New York.

Bulletin Announcement

Schutte & Koerting, Philadelphia, announce revision of their bulletin 4-E, covering steam jet exhausters, primers and compressors. These steam jet exhausters and compressors are air and gas pumps designed on the jet principle and using live steam or compressed air as the operating medium.

Copies of the bulletin will be mailed on request to the company.



Bronze Pump Studs

BUFFALO BRONZE DIE CAST CORPORATION

Buffalo Bronze Die Cast Corporation, Buffalo, New York, announce the manufacture of replacement cast parts for oil refinery equipment.

The company specializes on bronze studs for Worthington, National Transit, and other pumps, also valve studs and plates for National Transit Pumps.

These parts are cast from the company's No. 9 alloy aluminum bronze, which has the following characteristics: tensile strength 70,000 pounds, Brinnell hardness number about 110, fatigue test said to be four times the resistance of mild steel and 40 times that of manganese bronze, elongation 15 to 20 per cent, in two inches.

Studs are furnished by the Buffalo Bronze Die Cast Corporation either machined and threaded or left blank, for the purchaser to do his own machining.

Additional information can be had upon application to the company.

Refinery Equipment Paint

INTERNATIONAL COMPOSITIONS COMPANY, INC.

Tests on new protectives against hydrogen sulphide, started in the Gulf Coast more than a year ago by the International Compositions Company, Inc., 25 Broadway, New York, have been completed and the material is being put on the market.

It is well known that during cracking processes, hydrogen sulphide is evolved, which has the capacity of combining with steel surfaces, forming sulphide of iron. In this way the considerable thickness of the cylinders is rapidly reduced.

In 1926 the International Compositions Company set about the task of developing a paint for stills and the product now offered is the result.

Holzapfel's Heat Proof protective for cracking plants is said to withstand 1800 degrees of temperature and is insoluble in gasoline and its vapors, in water and steam, and is not affected by hydrogen sulphide.

The material as applied, consists of a liquid and a pigment which have to be mixed just before application. The mixture should be an intimate one, by energetic stirring for two or three minutes, after which it should be immediately applied. It should then be allowed to dry for 24 hours. After application of the second coat, which will dry automatically, the apparatus can then be closed and used.

Covering capacity of the paint is about 200 square feet to the gallon.

To protect the roofs of storage tanks, the company has also developed a paint. Tests have been made in various oil districts, and the paint has stood up well. Rubshell No. 5, as the paint is designated, is applied over Rubshell priming. Generally one coat of the priming is used with two coats of Rubshell No. 5.

Where severe acid conditions exist, Mr. Holzapfel states that one coat of Rubshell priming and two coats of Rubshell No. 2 give the best results.

Further information on these products can be secured from the J. A. Rossiter Company, Union National Bank Building, Houston, or from C. G. Clinch & Company, San Francisco, and San Pedro, California, or from the home office in New York.

Catalog Announcement

The Chemical Catalog Company, Inc., 419 Fourth Avenue, at 29th Street, New York, announces publication of the 1927 Chemical Engineering Catalog.

This book comprises catalog data of leading manufacturers of special equipment and machinery for the process industries including material handling equipment, power plant equipment, materials of construction, miscellaneous supplies for plant maintenance, scientific instruments and laboratory apparatus, and engineering service.

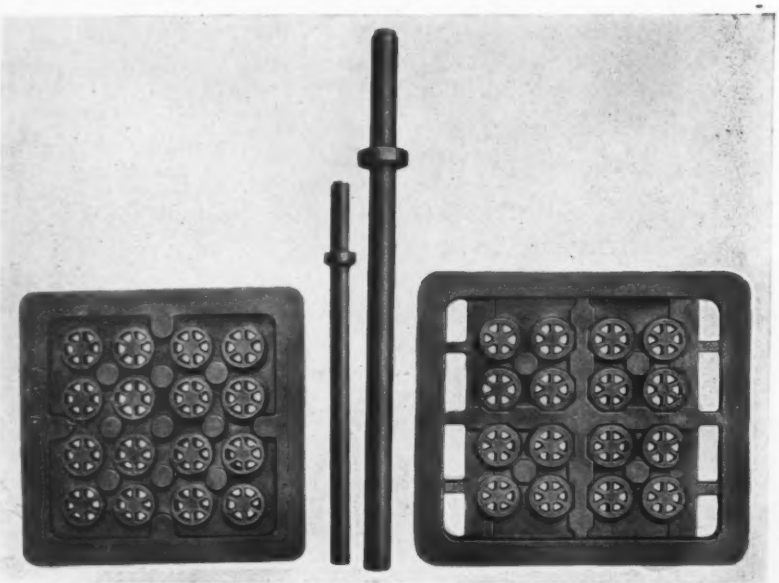
All equipment in the catalog is indexed and cross-referenced.

There is also a technical and scientific book section that describes a practically complete list of books in English on chemical and related subjects.

Further information on the catalog will be furnished on request from the publishers.

Bulletin Announcement

Bulletins describing the Gradon guided expansion joint, made by the Gradon Manufacturing Company, Land Title Building, Philadelphia, have been announced. Copies will be mailed upon request to the company.



Correct design insures satisfactory service

HEAT EXCHANGERS

are designed in every case to meet specified operating conditions.

Single- and Multiple-barrel Types.

We are equipped to build units of large capacities.

BULLETIN 12-H

Jets, valves, condensers, spray nozzles, heaters, coolers, gear pumps and oil burners for the oil industry.

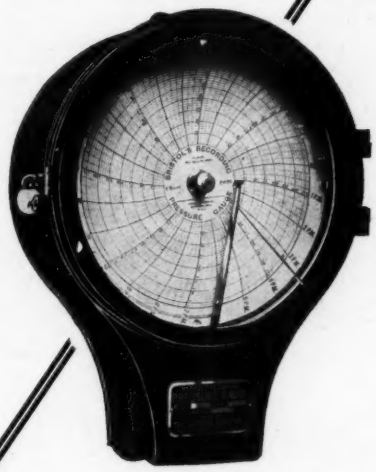
Send for illustrated booklet showing entire line of refinery equipment.

SCHUTTE & KOERTING CO.
1253 N. 12th St., Philadelphia, Pa.

After 30 Years of Continuous Service

1897–1927

Without Requiring Repairs



Bristol's Recording Pressure Gauge

has only recently been retired from active service at Manayunk Pumping Station, Philadelphia.

NO REPAIRS have been required during these three decades of service. Charts and ink are the only items appearing on the maintenance expense list.

Truly a fine record; one which reflects the excellent quality, and dependability of material and workmanship which has placed Bristol's Recording Instruments above the ordinary.

A survey of instrument needs in your plant made by Bristol Sales Engineers may bring out many interesting ideas for improving present operating conditions. Write.

The Bristol Company *Waterbury, Connecticut*

FOR 38 YEARS — Ask Any Technical Engineer — MAKERS OF

BRISTOL'S RECORDING INSTRUMENTS

Breather Tank Roof

CHICAGO BRIDGE & IRON WORKS

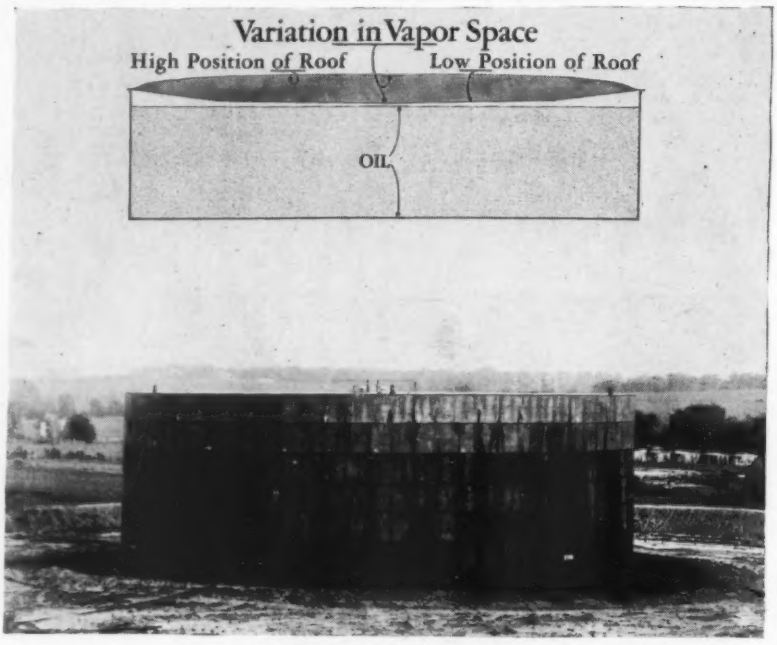
Chicago Bridge & Iron Works, 37 West Van Buren Street, Chicago, Illinois, is distributing information on the Wiggins Breather Roof, a new device recently developed by John H. Wiggins.

It is claimed that the Wiggins breather stops evaporation by providing a variable gas-tight volume to take care of expansion and contraction of the air-vapor mixture above the oil without allowing any of the vapor to escape.

The Wiggins breather may be constructed on old or new steel tanks in somewhat the same manner as an ordinary gas-tight steel roof. The steel plates are welded together and to the top of the tank shell, but are not fastened to the supporting framework. The distinctive feature of the breather is that the roof framework is designed so that the roof, when resting on it dips below the top of the tank shell and forms an inverted frustrum of a cone.

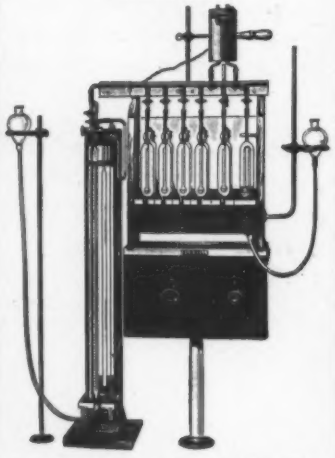
During the night, the breather roof on a tank full of oil is in its down position and is resting on the roof framework. As soon as the sun warms the air-vapor mixture above the oil, this mixture expands. Instead of some of the mixture being forced out of the tank, the roof flexes up enough to provide additional volume for expansion. The breather keeps rising slowly until the hottest part of the day and then when the mixture cools and contracts it returns slowly to the down position. No vapor is allowed to escape at any time.

The breather is equipped with a vacuum relief valve and volume relief for filling and emptying, and for emergencies. The vacuum relief is a liquid sealed vent of improved design. The volume relief valve is a mechanically operated valve which opens when the breather reaches its maximum upper operating limit.



WIGGINS BREATHER ROOF INSTALLED

BURRELL
De Luxe Safety Model
Standard-Burrell Gas Apparatus
For the Gas and Oil Industries



Completely Described in the New
BULLETIN NO. 750
A copy will be sent upon request.
Burrell Technical Supply Co.
CHEMICAL- BIOLOGICAL- METALLURGICAL
LABORATORY APPARATUS AND REAGENTS
1704-1708 FIFTH AVENUE PITTSBURGH, PA.

Haslam Goes to Chicago For Elliott Company

Jeannette, Penna.—The Elliott Company has announced that E. H. Haslam has recently been made district manager of its Chicago office, and that H. K. Gowdy has joined the organization as sales engineer in the Boston territory.

Mr. Haslam is a man of broad experience, particularly in the iron and steel industry. Beginning his career with Mackintosh-Hemphill & Company of Pittsburgh, he worked up from draftsman to chief engineer, vice president and general manager. Since he left that organization in 1920 he has served as supervisor of engineering and new construction for the Steel & Tube Company of America, and as superintendent of the Pittsburgh works of the Pressed Steel Car Company.

Mr. Gowdy has made a specialty of power plant work, his experience including work as chief engineer in power plants of the Newton & Boston Street Railway and the West Penn Power Company, as superintendent of power plants for the Pittsburgh Railways, and as chief steam engineer for the Cambria Steel Company at Johnstown. He has also been connected with the erection department of the Allis-Chalmers Company of New York and with the Standard Oil Company of New York as a traveling engineer.

New Concrete Covering

THE MASTER BUILDERS CO.

The Master Builders Company, 7016 Euclid Avenue, Cleveland, announces Stainproof, a new type of floor covering for use on concrete floors, or surfaces.

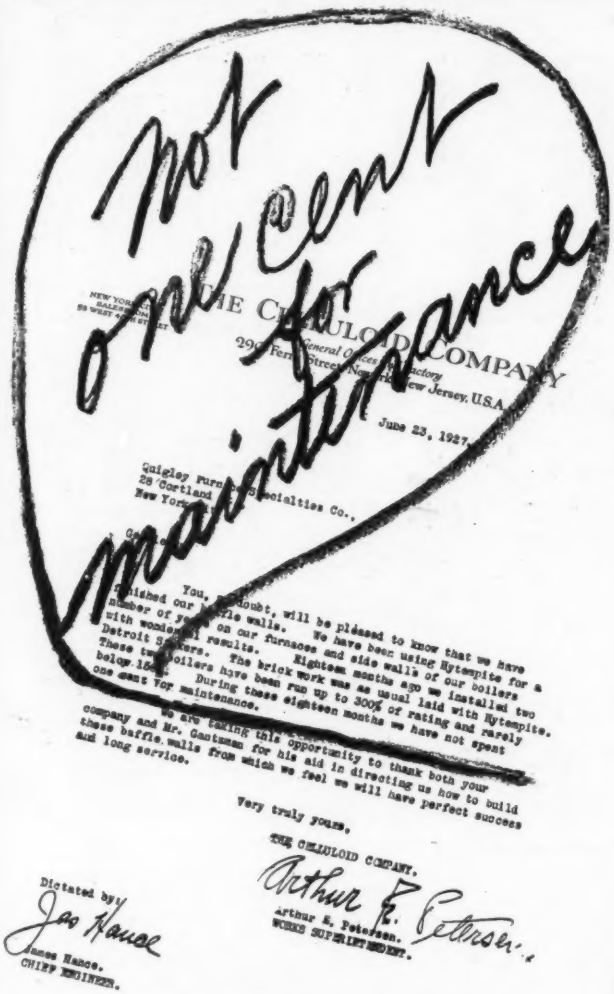
The covering is intended primarily to protect new concrete floors before they are fully cured. Stainproof is a jelly-like material specially prepared for application to fresh concrete. It is applied to the surface in a paint-like film 36 hours after the final troweling. It dries to form a non-pourous, viscous film through which paint, plaster, tobacco juice and similar staining agents cannot penetrate. The film is said to be so tough that the heavy traffic which new floors have to bear cannot grind through to leave its marks.

Then when the building is ready for occupancy, the film is removed, disclosing the new floor.

More information will be mailed on request to the company.

Carbon Plant Sold

Breckenridge, Texas.—The Texas Elf Carbon Company's carbon black plant in the Caddo district, Stephens County, has been sold to J. M. Huber, Inc., for a cash consideration of $200,000. The former company is owned jointly by Humble Oil & Refining Company and Godfrey L. Cabot, Inc., and has been burning residue gas from Humble's natural gasoline plants at the rate of about 4,000,000 cubic feet of gas daily. The plant is equipped with 24 double type of burning houses, and is rated at 6,000,000 cubic feet daily capacity.



HYTEMPITE

Highly Recommended

Because it gives entire satisfaction both for laying up fire brick and for building monolithic baffles. Maintenance costs are practically eliminated.

Hytempite is a plastic refractory material, scientifically compounded for bonding fire brick, building monolithic baffles and walls, making special shapes and for general repair work.

Use Hytempite and you will be able to say, "Not one cent for maintenance"

Quigley Furnace Specialties Co., Inc.
26 CORTLANDT ST. NEW YORK

Quick Service from Stock in Every Industrial Center

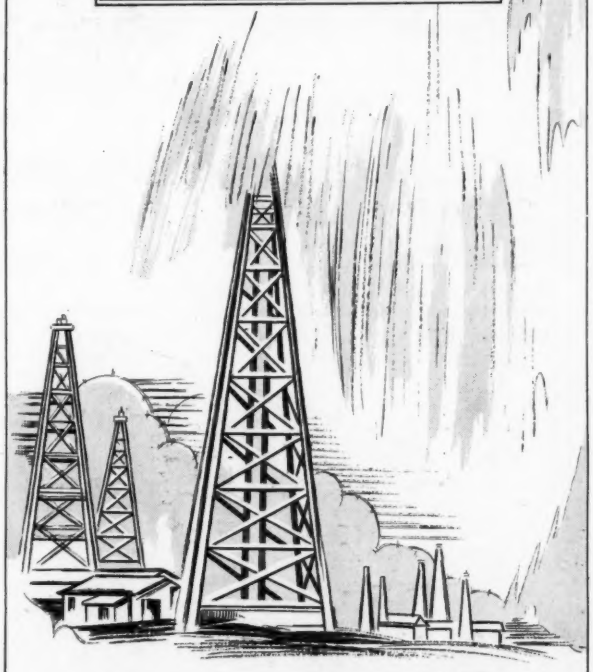
York Refrigeration

Low, dry temperatures, WHEN and WHERE you want them! In your processes or in your storages, adequate refrigeration is essential.

YORK Absorption Refrigerating machines are built in either the double pipe, atmospheric, or shell and tube types, and consist principally of the following parts:

Generator,
Analyzer,
Dehydrator,
Condenser,
Exchanger,
Weak Aqua Cooler,
Absorber,
Strong Aqua Tank,
Anhydrous Ammonia Receiver,
and Aqua Ammonia Pump.

Write for particulars on YORK refinery refrigeration.



YORK
ICE MACHINERY CORPORATION
YORK PENNA

YORK ICE MACHINERY CORPORATION,
York, Penna.

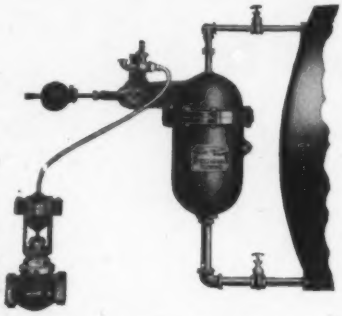
Without obligation on my part, please send me full particulars regarding your equipment for refinery refrigeration.

Name.....

Address.....

THE VIGILANT OIL LEVEL REGULATOR

for any type of absorber or steam still.



In the process of manufacture of gasoline by absorbing the gasoline in oil and subsequently separating the gasoline from the oil by distillation, it is essential that a constant oil level in both the absorbing tank and the still be maintained.

For this purpose the Vigilant Oil Level Regulator is manufactured. It is adaptable to any type of absorber or steam still and will maintain a constant oil level under all conditions of temperature and pressure.

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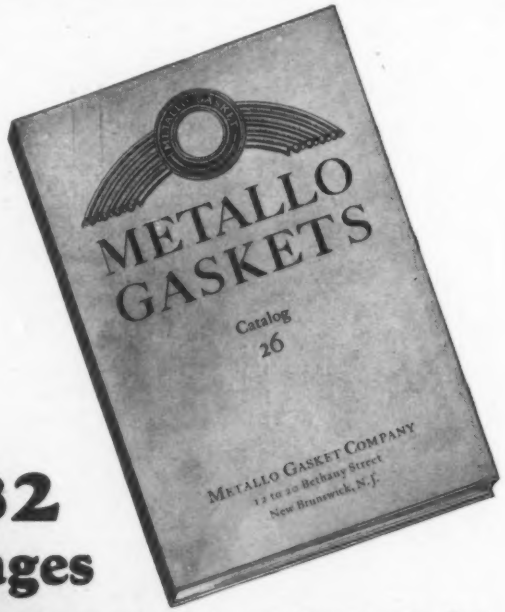

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Emery Plant Successful With Tube Still Distillation on Pennsylvania Crude

(Continued from page 50.)

The Emery organization is now installing an 870 horse power Erie City three-drum water tube boiler with an integral economizer, which will be automatically fed and operated and which is expected to operate over long periods at 200 per cent of its rating. This new plant will be one of the first, outside of the large plants, to be operated in the refining industry by firing with powdered or pulverized coal. It is said to be one of the first of the Erie type to be installed in field service.

Flue Gas Heat

At the time of the installation of the new tube still units the plan was confronted with inadequate steam or boiler capacity. To offset this Mr. Lackman decided to utilize two old second hand horizontal return tubular boilers which the company had on hand. In designing the tube still there was space enough allowed for the erection of these boilers in the flue passage between the tube still and the stacks. In operation these tube stills are caused to generate sufficient steam for their operation and for use in the shell still. The boilers are set in the flues to that the products of combustion must pass through the fire tubes to reach the stack. These hot flue gases effect the generation of steam in the boiler to a pressure of 40 pounds per square inch.

The boilers are supplied with water by an automatic feed water regulator and water is pumped into the boiler by electric driven small centrifugal pumps. Water is taken from the condenser boxes in this plant, since the water is soft, derived from wells on the plant grounds, and contains practically no scale forming solids. Water entering the boilers is preheated in this manner to about 150 degrees F.

This waste heater boiler installation makes the two distillation units in which they are installed virtually independent of the main power house for their operation. It is estimated that the utilization of this waste heat effects a saving in coal of about 10 tons per day, which is an item of some consequence. According to Mr. Lackman, the maximum temperature of flue gases in the base of the stack, after passing through the fire flues of the waste heat boilers, is around 380 to 390 degrees F., and sometimes falls much below those figures.

The application of this type of waste heat steam generating unit is of interest. In the installation discussed the cost was low because of the fact that the two old boilers were on hand, and the brickwork and insulation were the only items of major expense in the construction of the units. It is estimated that this installation of two boilers was accomplished at not more than $1200. It is, however, a step forward, and indicates that the refining industry might well utilize much of the great quantities of heat now sent up the stacks.

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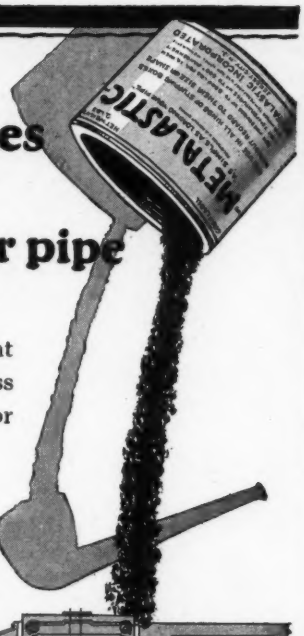

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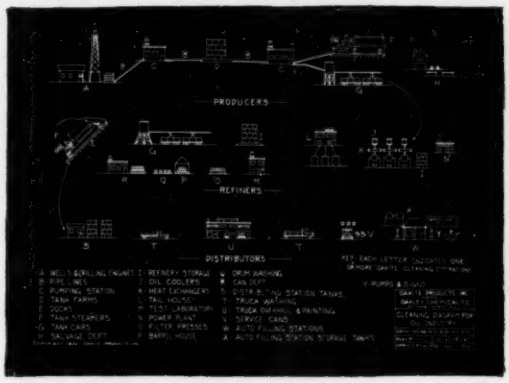

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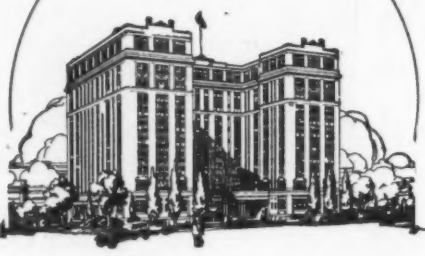

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Atlantic's First Diesel Powered Tanker at Sea

Philadelphia—The "Point Breeze," 7000-ton Diesel electric tanker, just completed by the Atlantic Refining Company at its Point Breeze plant, has had her trial runs and sailed August 29 on her maiden voyage to Europe with a cargo. Trials were run throughout the week ending August 28.

This boat, originally the "J. M. Connally," was purchased, with two others, from the United States Shipping Board and converted to Diesel-electric drive under the personal supervision of L. M. Goldsmith, technical engineer of the company. The remaining boats, the "Sharon" and the "Bessemer," are being reconditioned by the Alabama Dry Dock & Shipbuilding Company of Mobile, Alabama, and it will probably be a few months before the next one will go into service.

All three boats will probably be operated in coastwise service, but may occasionally be used in foreign service between American ports and South Africa or Europe. The former propulsion was of the steam type, but the new power plants will each consist of Ingersoll-Rand Diesel engines and electric equipment furnished by the General Electric Company. Each tanker is to be equipped with three 850-horsepower, 225 r. p. m., Diesel engines, each driving a 525 kilowatt, 250-volt generator for propulsion and a 50 kilowatt, 250 volt auxiliary generator for excitation and ship's auxiliary power. The propulsion generators will supply power to an 1800-horse power, 90 r. p. m., 750 volt double motor on each boat, direct connected to the propeller shaft. The control will be of the variable voltage type arranged for operation either from the pilot house or the engine room, the control panels being of the dead-front type.

The tankers will be fitted with electric auxiliaries, all of which will be driven by General Electric motors. The auxiliaries will include two 80-horsepower cargo pumps, one 45-horse-power windlass, one 30-horsepower mooring winch, one 30-horsepower fire and bilge pump, two 15-horsepower air compressors, a balancer set and numerous small pumps—as well as a 25-kilowatt auxiliary generator driven by an oil engine for emergency use in port.

Cameron Refining Co. Reorganized

Tulsa.—The Cameron Refining Company at Ardmore, which owns a 5000-barrel refinery there, has been reorganized as a unit of the Wirt Franklin oili interests. Reorganization followed the death of John Cameron, its organizer. Wirt Franklin is president, Edward Galt, P. C. Dings, Roy Johnson and Mrs. John Cameron are other directors of the company.

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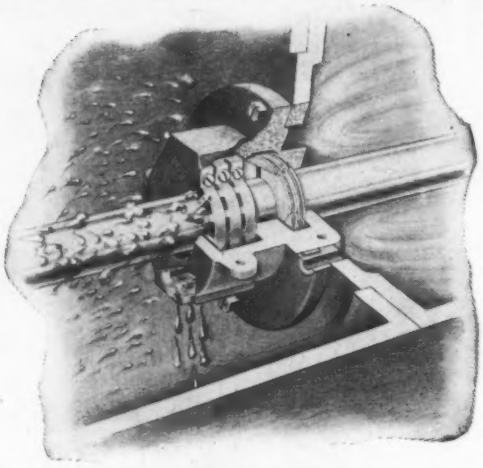

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GAS ENGINES

1. Greatly reduces the amount of oil consumed.
2. Eliminates oil being deposited on discharge valves and valve chambers.
3. Checks discharge of oil through the exhaust.
4. Stops forming of carbon deposits and oxidation.

AIR and GAS COMPRESSORS

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2. Eliminates oil being deposited on discharge valves, valve chambers, pipe lines and receivers.
3. Checks oil from being discharged by the cylinder into the compressed air and gas.
4. Stops the forming of carbon deposits and oxidation.

STEAM ENGINES

1. Greatly reduces the amount of oil consumed.
2. Stops the emulsifying of the lubricating oil.
3. Eliminates the inconvenience of having oil in exhaust steam where the steam is used for process work or radiation.

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PALMYRA, N. Y.

Manufacturers of "Quality Controlled" Mechanical Packings

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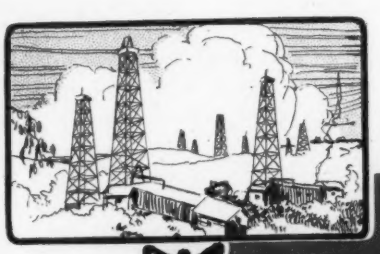

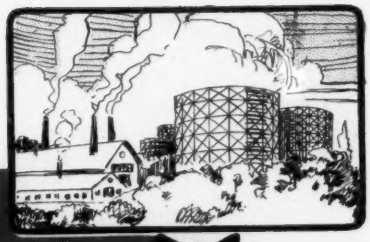

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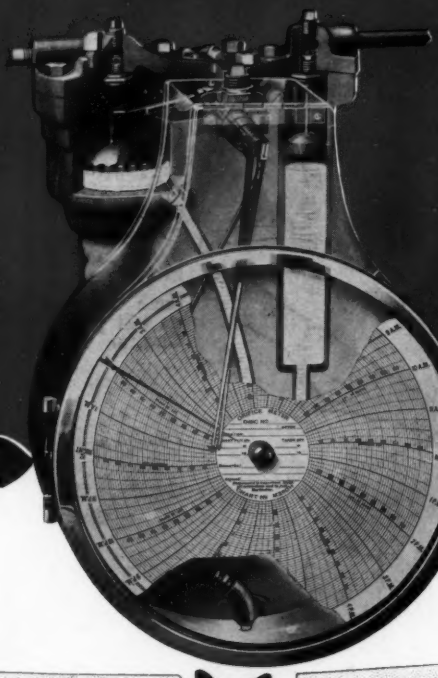

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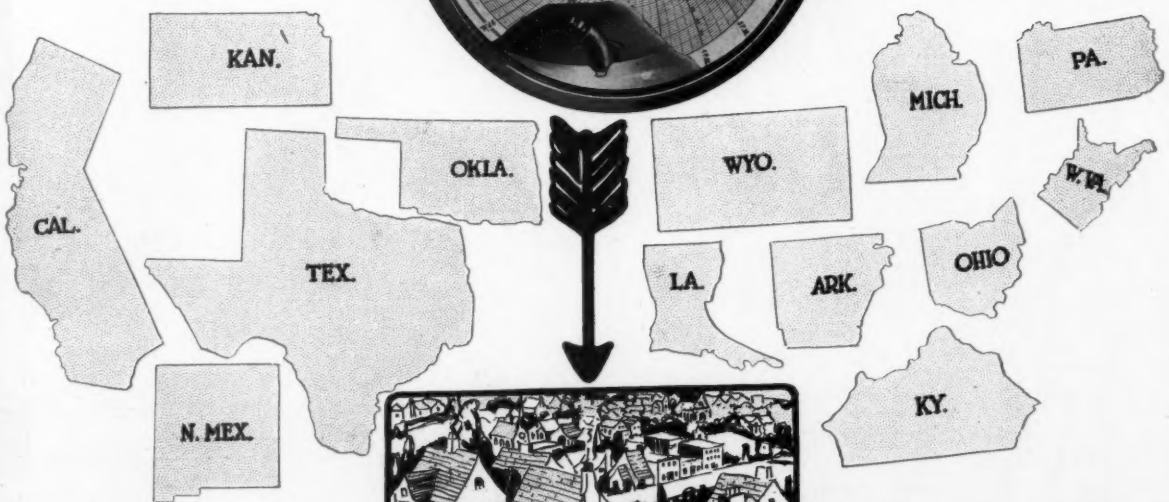

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